



forestry, fisheries & the environment

Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

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SPECIALIST DECLARATION FORM – AUGUST 2023

Specialist Declaration form for assessments undertaken for application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

REPORT TITLE

HERITAGE AND PALEONTOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF NEW SYSTEM 1 AT RAND WATER VEREENIGING TREATMENT WORKS, INSTALLATION OF APPROXIMATELY 7 KM PHASE 2 SLUDGE PIPELINE IN VEREENIGING, 1.5 KM SLUDGE LINE IN PANFONTEIN AND ASSOCIATED INFRASTRUCTURE WITHIN THE JURISDICTION OF SEDIBENG DISTRICT MUNICIPALITY, GAUTENG PROVINCE

Kindly note the following:

1. This form must always be used for assessment that are in support of applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting, where this Department is the Competent Authority.
2. This form is current as of August 2023. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at <https://www.dffe.gov.za/documents/forms>.
3. An electronic copy of the signed declaration form must be appended to all Draft and Final Reports submitted to the department for consideration.
4. The specialist must be aware of and comply with ‘*the Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the act, when applying for environmental authorisation - GN 320/2020*’, where applicable.

1. SPECIALIST INFORMATION

Title of Specialist Assessment	Heritage Impact Assessment
Specialist Company Name	Tsimba Archaeological Footprints (Pty) Ltd
Specialist Name	Roy Muroyi
Specialist Identity Number	FN560892
Specialist Qualifications:	MA Heritage, MA CDS , Hon Archaeology
Professional affiliation/registration:	ASAPA and APHP
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20 July 2025

Dr Ragna Redelstorff
Heritage Officer Archaeology, Palaeontology & Meteorites Unit
South African Heritage Resources Agency
111 Harrington Street
Cape Town 8001

Dear Dr Redelstorff

RE: Request for Exemption of any Palaeontological Impact Assessment for the proposed construction and maintenance of New system 1 at Rand water Vereeniging treatment works, installation of approximately 7 km phase 2 Sludge pipeline in Vereeniging, 1.5 km sludge line in Panfontein and associated infrastructure within the jurisdiction of Sedibeng District Municipality, Gauteng Province

In my capacity as a professional palaeontologist, I am requesting exemption for palaeontological impact assessment in terms of the National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998) which requires that the proposed development must be preceded by the relevant impact assessment, in this case for palaeontology.

The proposed project spans three locations but remains within the jurisdiction of the Servitude of Rand Water within the Sedibeng District Municipality.

New System 1 Vereeniging

The Vereeniging New System 1 at Rand Water Vereeniging Treatment Works will consist of the following infrastructure but not limited to:

- Construction of a new 250 MLD flocculator and 225 MLD sedimentation tank. ▪ Installation of the de-sludge bridge.
- Construction of access roads.
- Installation of a raw water pipeline.
- Installation of a sludge pipeline.
- Demolition of System 1 tank (90 MLD) to allow for the installation of a new automated system capable of producing 1400 MLD.
- Construction of a Laboratory and
- The installation of a new Carbon Dioxide dosing Carbonisation Bay.

Phase 2 Sludge Pipeline in Vereeniging

- Phase 2 of the sludge pipeline starts from the sludge pumping station inside Vereeniging Treatment Works and runs through mostly an established industrial area in the south of Vereeniging.

SPECIALIST DECLARATION FORM – AUGUST 2023

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Roy Muroyi, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.




Signature of the Specialist

Tsimba Archaeological Footprints

Name of Company

21 Aug 2025

Date



Signature of the Commissioner of Oaths

21 Aug 2025

Date

21/08/2025

JACOBUS JOHANNES ENSLIN
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SPECIALIST DECLARATION FORM – AUGUST 2023

2. DECLARATION BY THE SPECIALIST

I, Roy Muroyi declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. “the Protocols”) and in Government Notice No. 1150 of 30 October 2020.
- 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 the specialist report relevant to this application, 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 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;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the NEMA Act.



Signature of the Specialist

Tsimba Archaeological Footprints (Pty) Ltd

Name of Company:

21 Aug 2025

Date

- The proposed sludge pipeline runs alongside as well as across some of these services, which also include Rand Water Bulk Water Pipelines to the Vaal River Crossing.
- The installation of approximately 7 km in length of 1000mm nominal internal diameter steel sludge pipe with an 8mm wall thickness to be laid from the Vereeniging Pumping Station to the Vaal River Crossing.

Panfontein Sludge Pipeline

The Panfontein Sludge Pipeline will consist of the installation of an interconnection new sludge pipeline with approximately 1.5km in length and 800mm in diameter.



Figure 1: New System 1 (Vereeniging) Locality Map



Figure 2: Phase 2 Sludge Pipeline Locality Map



Figure 3: Panfontein Sludge Pipeline Locality Map

Background to Palaeontology of the study areas

The site New System 1 and Phase 2 Sludge Pipeline are located on very highly sensitive rocks of the Vryheid Formation (Ecca Group, Karoo Supergroup) that might have fossil plants of the Glossopteris flora (Johnson et al., 2006). The Panfontein Sludge Pipeline site is covered by soils and has been disturbed by previous urban and light infrastructural activities. This is a small outcrop of shales overlying the much older rocks of the Malmani Subgroup. Any surface fossils would have been badly weathered and turned to soils. It is unlikely that any fossils were disturbed by the installation of a diesel depot. No fossils have been reported from this area. Although the SAHRIS palaeosensitivity map indicates the site as very highly sensitive (red, Fig. 4) it is likely to be low, therefore, no further palaeontological impact should be required.



Figure 4: The paleontological sensitivity of New System 1 (Vereeniging) showing the palaeontological sensitivity to be **VERY HIGH.**



Figure 5: The paleontological sensitivity of Phase 2 Sludge Pipeline area showing the palaeontological sensitivity to be **VERY HIGH**.

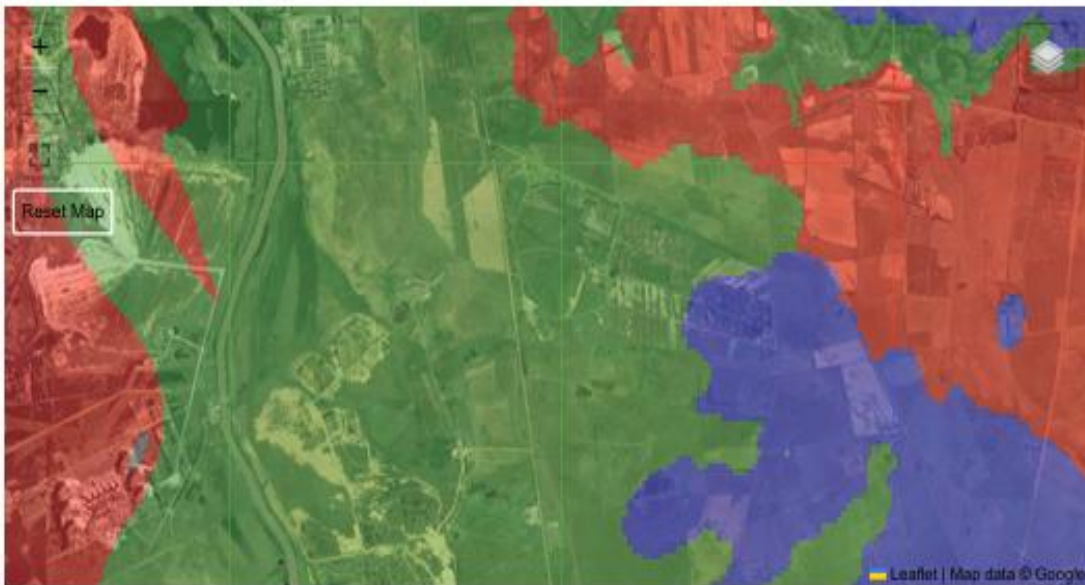


Figure 6: The paleontological sensitivity of Panfontein Sludge Pipeline area showing the palaeontological sensitivity to be **MODERATE**.

Plaeontological Background of the region

A very wide range of possible fossil remains occur in the Vereeniging region, though these are often sparse, such as: mammalian bones and teeth, tortoise remains, ostrich eggshells, non-marine mollusc shells, ostracods, diatoms, and other micro fossil groups, trace fossils (e.g. calcretised termitaria, rhizoliths, burrows, vertebrate tracks), freshwater stromatolites, plant material such as peats, foliage, wood, pollens, within calc tufa. Stromatolite structures range from a centimetre to several tens of metres in size. They are the result of algal growth in shallow water, indicating a very rich growth that would have caused an enrichment in the amount of oxygen in the atmosphere (Groenewald and Groenewald 2014).

The Ecce Group, Vryheid Formation to the north may contain fossils of diverse non-marine trace, *Glossopteris* flora, mesosaurid reptiles, palaeoniscid fish, marine invertebrates, insects, and crustaceans (Johnson 2009). *Glossopteris* trees rapidly colonised the large deltas along the northern margin of the Karoo Sea. Dead vegetation accumulated faster than it could decay, and thick accumulations of peat formed, which were ultimately converted to coal. It is only in the northern part of the Karoo Basin that the glossopterids and cordaitales, ferns, clubmosses and horsetails thrived (McCarthy and Rubidge 2005).

The Glossopteris flora is thought to have been the major contributor to the coal beds of the Ecce. These are found in Karoo-age rocks across Africa, South America, Antarctica, Australia and India. This was one of the early clues to the theory of a former unified Gondwana landmass (Norman and Whitfield 2006).

Chemical sediments such as fine-grained limestone and dolomite of the Malmani Subgroup is made up of deposits of organically derived carbonate shells, particles or precipitate. Dolomite is magnesium-rich limestone formed from algal beds and stromatolites. These Early Proterozoic Transvaal stromatolitic dolomites formed and released free oxygen at around 2900 – 2400 Ma. Stromatolites are common in the Malmani dolomites, accepted to be the fossil remnants of the simplest single-celled organisms. They are finely layered, concentric, mound-like structures formed by microscopic algal organisms (Norman and Whitfield 2006). Chert may contain fossils such as echinoids or sponges if nodular, although not common and is rated unlikely.

One of the formations (Black Reef) in the development area may contain fossils. Nixon *et al.* (1988) described the black shales south-west of Potchefstroom as consisting of overlapping laminated basal mounds which are stromatolitic as well as spheroidal possible planktonic fossil algae. These can range in size from 3.5 - 17 mm in height and up to 10 mm in diameter and can be present in the development area.

The Black Reef Formation is known for stromatolite carbonates and fossiliferous Late Cenozoic cave breccias similar to the Malmani dolomite. Algal microfossils are reported from shales and are probably from diagenetic origin. Stromatolites are preserved in the subordinate carbonate rocks.

Conclusion: When rock units of **MODERATE** to **VERY HIGH** palaeontological sensitivity are present within the development footprint, a desk top and or field scoping (survey)

study by a professional palaeontologist is usually warranted. The main purpose of a field scoping (survey) study would be to identify any areas within the development footprint where specialist palaeontological mitigation during the construction phase may be required. The proposed development areas are however extensively disturbed due to previous or existing infrastructure. Since there is no chance at all of finding fossils in the project footprint we request exemption from any further palaeontological impact assessment.

Yours faithfully

References cited:

GROENEWALD, G.H. and GROENEWALD D. 2014. Palaeotechnical Report for the Gauteng Province, South African Heritage Resources Agency, Pp 20.

JOHNSON, M.R. 2009. Ecca Group. Karoo Supergroup. Catalogue of South African Lithostratigraphic Units. SACS, **10**: 5-7.

MCCARTHY, T and RUBIDGE, B. 2005. *The Story of Earth Life: A southern African perspective on a 4.6-billion-year journey*. Struik. Pp 333.

NORMAN, N. and WHITFIELD, G., 2006. *Geological Journeys*. De Beers, Struik, Pp 1-320.
RUBIDGE, B. S. (ed.), 1995. Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Biostratigraphy, Biostratigraphic Series No. 1, 46pp. Council for Geoscience, Pretoria.

SG 2.2 SAHRA APMHOB Guidelines, 2012. Minimum standards for palaeontological components of Heritage Impact Assessment Reports, Pp 1-15.

Palaeosensitivity map:

<https://sahris.sahra.org.za/map/palaeo>

Declaration of Independence

This letter has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Tsimba Archaeological Footprints (Pty) Ltd, Johannesburg, 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:

MKBamford

**Palaeontological Impact Assessment for the
Rand Water Vereeniging Treatment Plant,
upgrade and maintenance, Sedibeng,
Gauteng Province**

Desktop Study (Phase 1)

Subcontracted by

Tsimba Archaeological Footprints (Pty) Ltd

26 August 2025

Prof Marion Bamford

Palaeobotanist

P Bag 652, WITS 2050

Johannesburg, South Africa

Marion.bamford@wits.ac.za

1. Executive Summary

A Palaeontological Impact Assessment was requested for the Rand Water construction and Maintenance of New System 1 at Rand Water Vereeniging Treatment Works, the installation of approximately 7 Km Phase 2 Sludge Pipeline in Vereeniging, and a 1.5 Km Sludge Line in Panfontein, and Associated Infrastructure within the jurisdiction of Sedibeng District Municipality, Gauteng Province, South Africa.

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.

Phase 1 and part of phase 2 lie on potentially very highly sensitive sediments of the Vryheid formation but the area is very disturbed and covered with soil. Phase 3 (Pantfontein Sludge Line) is on moderately sensitive Quaternary Aeolian sands. 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, drilling or mining activities have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Very High	Low	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 Tsimba Foort Prints (Pt) Ltd, Johannesburg, 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

Rand Water (applicant) proposes the construction & Maintenance of New System 1 at Rand Water Vereeniging Treatment Works, the installation of approximately 7 Km Phase 2 Sludge Pipeline in Vereeniging, and a 1.5 Km Sludge Line in Panfontein, and Associated Infrastructure within the jurisdiction of Sedibeng District Municipality, Gauteng Province, South Africa.

The proposed project spans three locations but remains within the jurisdiction of the Servitude of Rand Water within the Sedibeng District Municipality, Gauteng Province, South Africa. The coordinates to the three sites are as follows (refer to the locality maps and the tables below).

3.1 New System 1 Vereeniging

The Vereeniging New System 1 at Rand Water Vereeniging Treatment Works will consist of the following infrastructure:

- Construction of a new 250 MLD flocculator and 225 MLD sedimentation tank.
- Installation of the de-sludge bridge.
- Construction of access roads.
- Installation of a raw water pipeline.
- Installation of a sludge pipeline.
- Demolition of System 1 tank (90 MLD) to allow for the installation of a new automated system capable of producing 1400 MLD.
- Construction of a Laboratory and
- The installation of a new Carbon Dioxide dosing Carbonisation Bay.

The project is located in Vereeniging, Emfuleni Local Municipality, on Portion 111 of Farm Leeuwkuil 596 IQ (Figures 1-3)

3.2 Phase 2 Sludge Pipeline in Vereeniging – on portions of Farms Leeuwkuil 596 IQ, Klipplaad drift 601 IQ, Usco 603 IQ and Uitvlugt 434 IR

Phase 2 of the sludge pipeline starts from the sludge pumping station inside Vereeniging Treatment Works and runs through mostly an established industrial area in the south of Vereeniging.

The proposed sludge pipeline runs alongside as well as across some of these services, which also include Rand Water Bulk Water Pipelines to the Vaal River Crossing.

The installation of approximately 7 km in length of 1000mm nominal internal diameter steel sludge pipe with an 8mm wall thickness to be laid from the Vereeniging Pumping Station to the Vaal River Crossing.

3.3 1.5km Panfontein Sludge Pipeline – located in Panfontein in the Midvaal Local Municipality on portions of Farm Pantfontein 437 IR.

The Panfontein Sludge Pipeline will consist of the installation of an interconnection new sludge pipeline with approximately 1.5km in length and 800mm in diameter

Selable Consultancy and Projects (Pty) Ltd (herein referred to as SCP) team has approached this proposal with a great deal of experience in undertaking EIAs and all related Environmental Services. SCP has a team of specialists with the capacity and background to undertake the fieldwork and compile the reports within the required timeframes.

A Palaeontological Impact Assessment was requested for the Vereeniging Rand Water Treatment Plant upgrade 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. The minimum requirements for reporting are listed in Table 1,

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	N/A
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	N/A

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
	buffers;	
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
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	N/A
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: Aerial map of the Vereeniging New system 1 (red). All maps supplied by SCP.



Figure 2: Aerial Map of the Phase 2 Sludge Pipeline.



Figure 3: Aerial map of the Panfontein Sludge Pipeline.

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



Figure 4: Geological map of the area around the Vereeniging Rand Water project as is indicated within the blue outlines. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2626 West Rand (west) and 2628 East Rand (east).

Table 2: Explanation of symbols for the geological map and approximate ages (Botha, 2020; Eriksson et al., 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
Qs	Quaternary	Alluvium, sand	Quaternary ca 1.0 Ma to Present
Qw	Quaternary	Aeolian sand	Quaternary ca 1.0 Ma to Present
Pv	Vryheid Fm, Eccca Group, Karoo SG	Shales, sandstone, coal	Early Permian, Middle Eccca
C-Pd	Dwyka Group, Karoo SG	Tillites, diamictite, sandstone, mudstone	Late Carboniferous to Early Permian
Vh	Hekpoort Fm, Pretoria Group, Transvaal SG	Andesite, quartzite, volcanic rocks	Palaeoproterozoic Ca
Vmd	Malmani Subgroup, Chuniespoort Group,	Dolomite, chert	Ca 2750 – 2650 Ma

Symbol	Group/Formation	Lithology	Approximate Age
	Transvaal SG		
Vbr	Black Reef Fm, Transvaal SG	Quartzite, conglomerate, shale, basalt	Ca 2650 – 2640 Ma
Rk	Klipriviersberg Group, Ventersdorp SG	Andesite, tuff	Neoproterozoic Ca 2714 Ma

The project lies in the southern margin of the Transvaal Basin where rocks of the Transvaal Supergroup are exposed (Figure 4). They are unconformably overlain by sediments of the Karoo Supergroup that in turn are overlain by much younger sands and alluvium that were deposited during the late Quaternary in basins and valleys.

TRANSVAAL SUPERGROUP

The Late Archaean to early Proterozoic Transvaal Supergroup is preserved in three structural basins on the Kaapvaal Craton (Eriksson et al., 2006). In South Africa are the Transvaal and Griqualand West Basins, and the Kanye Basin is in southern Botswana. The Transvaal Supergroup comprises one of world's earliest carbonate platform successions (Beukes, 1987; Eriksson et al., 2006; Zeh et al., 2020). In some areas there are well preserved stromatolites that are evidence of the photosynthetic activity of blue green bacteria and green algae. These microbes formed colonies in warm, shallow seas.

In the Transvaal Basin the Transvaal Supergroup is divided into two Groups, the lower Chuniespoort Group and the upper Pretoria Group (with ten formations; Eriksson et al., 2006). The Chuniespoort Group is divided into the basal Malmani Subgroup that comprises dolomites and limestones and is divided into five formations based on chert content, stromatolitic morphology, intercalated shales and erosion surfaces. The top of the Chuniespoort Group has the Penge Formation and the Deutschland Formation.

KAROO SUPERGROUP

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.

Overlying the basal Dwyka Group glaciogenic 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 west and central part are the following formations, from base upwards: Pietermaritzburg Formation, Vryheid Formation and the Volksrust Formation. 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.

QUATERNARY

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 the eastern areas 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 Figure 5. The Vereeniging treatment plant and pipelines (projects 1 and 2) are on the potentially very highly sensitive Vryheid Formation (red) while the Pantfontein Sludge pipeline (project 3) is on moderately sensitive Quaternary sands (green).

In some areas like the Highveld and Witbank Coalfields, the **Vryheid Formation** has extensive coal seams of Early Permian age. Although coal is formed from buried peat that is altered over time by high temperatures and pressures, the original plants that made the peat are not recognisable. The carbonaceous shale bands and lenses between the coal seams are more likely to preserve impressions of the plants. They are typical plants of the *Glossopteris* flora that includes leaves, seeds, reproductive structures and wood of *Glossopteris*, as well as other plants such as lycopods, sphenophytes, ferns and early gymnosperms. The area is covered with soils and is very disturbed so no plants would be visible on the surface.



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 site for the three phases (projects) for the Rand Water Vereeniging Water Treatment plant shown within the yellow rectangles.

Fossil plants have been collected from the old clay pits to the west on Farm Leeuwkuil but only from the clay layers that occurred well below the surface (Plumstead, 1969; Anderson and Anerson, 1985).

Quaternary aeolian sands are windblown and friable so they do not preserve any fossils; fossils require low-energy, anoxic environment such as muds in waterbodies, to preserve organic matter. Sand-sized fragments of fossils might be incorporated in the sands but they would be unrecognisable and so of no value to science.

From the SAHRIS map above the Western parts are very highly sensitive (red) BUT the area is already very disturbed from existing infrastructure, roads, pipes and buildings. In the east the Pantfontein Sludge Pipe is on moderately sensitive Quaternary aeolian sands (green). The latter is unlikely to preserve any fossils either.

6. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

Table 3a: Criteria for assessing impacts

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	H	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	L	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	L	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

PROBABILITY (of exposure to impacts)	H	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

Table 3b: Impact Assessment

PART B: Assessment		
SEVERITY/NATURE	H	-
	M	-
	L	Sands and soil do not preserve fossils; so far there are no records from the Vryheid Fm of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be negligible
	L+	-
	M+	-
	H+	-
	DURATION	L
M		-
H		Where manifest, the impact will be permanent.
SPATIAL SCALE	L	Since the only possible fossils within the area would be fossil plants deep below the surface in the clays, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	It is extremely unlikely that any fossils would be found in the loose soils and sands that cover the area or in the soils that cover the Vryheid Fm that will be excavated. Nonetheless, a Fossil Chance Find Protocol should be added to the eventual EMPr.

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 age to contain fossils in the west but the wrong type in the east. Furthermore, the material to be excavated is soil and this does not preserve fossils. Since there is a small chance that fossils from the Vryheid Formation may be disturbed 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 low.

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.

8. Recommendation

Based on experience and the lack of any previously recorded fossils from the surface area, it is extremely unlikely that any fossils would be preserved in the overlying soils of the Quaternary. There is a very small chance that fossils may occur in clay layers well below surface in the Vryheid Formation so a Fossil Chance Find Protocol should be added to the EMP. If fossils are found by the environmental officer, or other responsible person once excavations 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 low, 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	Low	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 activities begin.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations 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 6). 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 a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA 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 SAHRA 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 6: Photographs of fossil plants from the Vryheid Formation to assist the on-site responsible person.