

Proposed Walkerville Village Mews Development

Midvaal Local Municipality, Sedibeng District, Gauteng Province

Farm: Portion 174 (a Portion of Portion 29) of Faroasfontein 372-IQ

Fourie, H. Dr heidicindy@yahoo.com

012 322 7632/012 993 3110

Palaeontological Impact Assessment: Desktop study

Facilitated by: ENVIROSYNERGY CONSULTING

Postnet Suite 783, Private Bag 37, Lynwoodridge, 0040

Tel: 079 824 7255

2016/11/11

Ref: GAUT 002/16-17/E0028



B. Executive summary

Outline of the development project: ENVIROSYNERGY CONSULTING has facilitated the appointment of Dr H. Fourie, a palaeontologist, to undertake a Paleontological Impact Assessment (PIA), Desktop Study of the suitability of the proposed Walkerville Village Mews development, with related infrastructure on Portion 174 (a Portion of Portion 29) of the Farm Faroasfontein 372-IQ in the Midvaal Local Municipality, Sedibeng District in the Gauteng Province. The request for the study came from SAHRA's initial comment on the Draft Basic Assessment Report that was circulated for public comment.

The applicant, Walkerville Village Mews, proposes to develop the property in to a 'sustainable living' and greener technologies facilities including retirement housing and open spaces.

The Project includes one layout alternative (see google.earth image):

Option 1: A block outlined in blue with the R82 Road as the north-south route which links Vereeniging and Johannesburg via Walkerville, the R557 Road is to the northeast. The site is approximately 19.872 hectares including 4.396 hectares of open space.

Legal requirements:-

The **National Heritage Resources Act (Act No. 25 of 1999) (NHRA)** requires that all heritage resources, that is, all places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance are protected. The Republic of South Africa (RSA) has a remarkably rich fossil record that stretches back in time for some 3.5 billion years and must be protected for its scientific value. Fossil heritage of national and international significance is found within all provinces of the RSA. South Africa's unique and non-renewable palaeontological heritage is protected in terms of the National Heritage Resources Act. According to this act, palaeontological resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

The main aim of the assessment process is to document resources in the development area and identify both the negative and positive impacts that the development brings to the receiving environment. The PIA therefore identifies palaeontological resources in the area to be developed and makes recommendations for protection or mitigation of these resources.

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

For this study, resources such as geological maps, scientific literature, institutional fossil collections, satellite images, aerial maps and topographical maps were used. It provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations (if any) for further specialist palaeontological input where this is considered necessary.

A Palaeontological Impact Assessment is generally warranted where rock units of LOW to VERY HIGH palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed area is unknown. The specialist will inform whether further monitoring and mitigation are necessary.

Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act No.25 of 1999):

(i) (i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens.

This report adheres to the guidelines of Section 38 (1) of the National Heritage Resources Act (Act No. 25 of 1999).

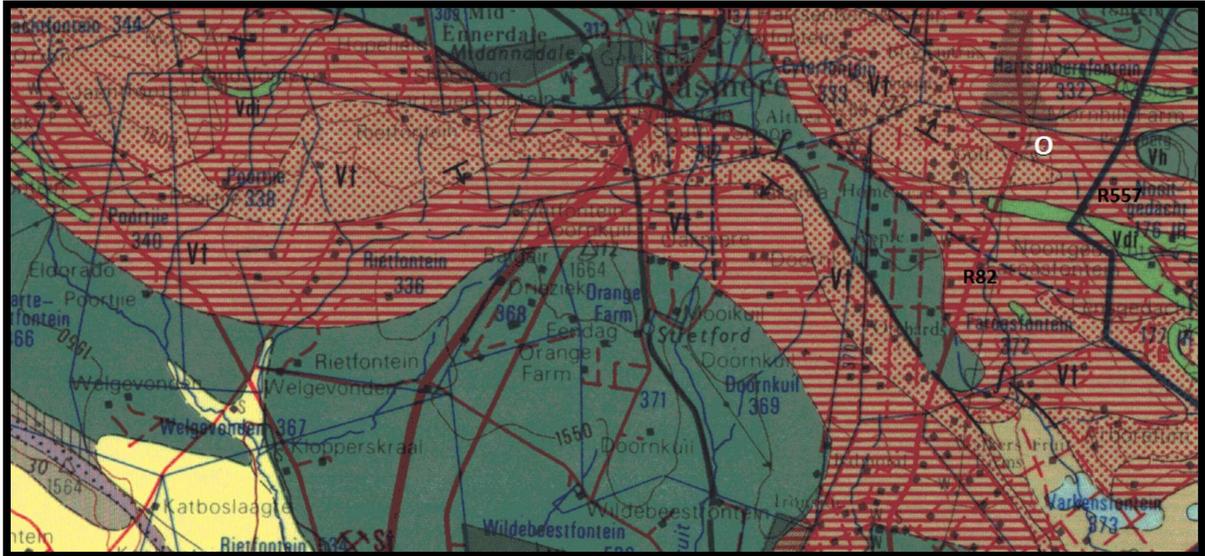
Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as (a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length; (b) the construction of a bridge or similar structure exceeding 50 m in length; (c) any development or other activity which will change the character of a site (see Section 38); (d) the re-zoning of a site exceeding 10 000 m² in extent; (e) or any other category of development provided for in regulations by SAHRA or a PHRA authority.

This report aims to provide comment and recommendations on the potential impacts that the proposed development could have on the fossil heritage of the area and to state if any mitigation or conservation measures are necessary.

Outline of the geology and the palaeontology:

The geology was obtained from map 1:100 000, Geology of the Republic of South Africa (Visser 1984) and the 1:250 000 (2626) Geological Map of the West Rand (Keyser 1986).

Figure 3: The geology of the development area (Keyser 1986).



Legend to Map and short explanation.

Vdi – Diabase (green), Vaalian.

Vh – Andesite, agglomerate, tuff (green), Hekpoort Formation, Pretoria Group, Transvaal Supergroup.

Vt – Ferruginous quartzite [::], ferruginous shale, hornfels [=] (brown), Time Ball Hill Formation, Pretoria Group, Transvaal Supergroup.

---f--- (black) Fault.

⊥ 20 - Strike and dip of bed.

O – Approximate position of Walkerville (edge of map).

Mining Activities

None.

Summary of findings: The Palaeontological Impact Assessment: Desktop study was undertaken in November 2016 in the summer in dry and hot conditions, as this is a desktop study the season (Appendix 6 of Act, 1(d)) has no influence on the outcome, and the following is reported:

The development is taking place on the Time Ball Hill quartzite Formation of the Pretoria Group, Transvaal Supergroup.

The Transvaal Supergroup fills an east-west elongated basin in the south-central part of the old Transvaal (now North – West, Gauteng and Mpumalanga) as far south as Potchefstroom. It is Vaalian in age, approximately 2600 Ma to 2100 Ma. A maximum thickness of the Transvaal Supergroup reaches 2000 m in the north-eastern section. The east-west elongated basin is filled with clastic, volcanic and chemical sedimentary rocks. Three groups based on lithological differences have been established: they are the Rooiberg, Chuniespoort, and Pretoria Groups as well as other smaller groups (Kent 1980, Snyman 1996). It is the Bushveld Complex that is responsible for the tilting of the Transvaal sediments and the heat of its intrusion having created andalusite crystals (Norman and Whitfield 2006). This Supergroup is underlain by the Ventersdorp, Witwatersrand and Pongola Supergroups, and the Dominion Group. Three prominent ridges are present from the oldest to the youngest, the Time Ball Hill, Daspoort and Magaliesberg Formations (Norman and Whitfield 2006).

The Pretoria Group consists predominantly of quartzite and shale, together with a prominent volcanic unit, minor conglomerate, chemical and volcanic members. It comprises the Hekpoort Andesite, Dullstroom Basalt, Time Ball Hill, Silverton, and Magaliesberg Quartzite Formations as well as several smaller formations (in total 15) and overlies the Chuniespoort Group (Kent 1980). Both the shale and quartzite of the Pretoria Group are utilised in the building industry (Snyman 1996). The Time Ball Hill shale Formation is known to contain 'algal microfossils' diagenetic in origin. Stromatolites as they are known are preserved in the subordinate carbonate rocks (Kent 1980). The Pretoria Group is clastic sedimentary in nature (Eriksson 1999). The pile of sedimentary rocks, mainly mudstones and quartzites with some basalt can collectively reach a thickness of up to 5 km.

Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity can generally be LOW to VERY HIGH, and here locally HIGH for the Pretoria Group including the Time Ball Hill Formation (SG 2.2 SAHRA APMHOB, 2012).

Recommendation:

The impact of the development on fossil heritage is HIGH and therefore a field survey or further mitigation or conservation measures may be necessary for this development (according to SAHRA protocol). A Phase 1 Palaeontological Impact Assessment and or mitigation may be recommended. The overburden and inter-burden must always be surveyed for fossils. Special care must be taken during the digging, drilling, blasting and excavating of foundations, trenches, channels and footings and removal of overburden not to intrude fossiliferous layers.

Table 2: Criteria used (Fossil Heritage Layer Browser/SAHRA):

Rock Unit	Significance/vulnerability	Recommended Action
Pretoria Group	High	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely
Time Ball Hill	High	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely
Hekpoort Formation	Moderate	Desktop study is required

The Time Ball Hill Formation is present here in the development area. It contains stromatolites.

The Project includes one layout alternative (see google.earth image) as approved by the Gauteng Department of Agriculture and Rural Development on 20 October 2016:

Option 1: A block outlined in blue with the R82 Road as the north-south route which links Vereeniging and Johannesburg via Walkerville, the R557 Road is to the northeast. The site is approximately 19.872 hectares including 4.396 hectares of open space.

Concerns/threats:

1. Threats are earth moving equipment/machinery (front end loaders, excavators, graders, dozers) during construction, the sealing-in, disturbance, damage or destruction of the fossils by development, vehicle traffic and human disturbance.
2. Mitigation is not needed.
3. No consultation with parties was necessary.
4. Caution is recommended as stated above (due to the presence of stromatolites), a field assessment is not recommended, but the developer needs to follow protocol (attached) for the shale layer if any fossils are uncovered. In such a case SAHRA must be notified immediately.

Stakeholders: Developer – Walkerville Village Mews – P.O. Box 932, Walkerville, 1876.

Environmental – ENVIROSYNERGY, Postnet Suite 783, Private Bag 37, Lynwoodridge, 0040, Tel. 079 824 7255.

Landowner – Walkerville Village Mews – 84 On Main Shopping Centre, 82 Main Road, Walkerville.

C. Table of Contents

A. Title page	1
B. Executive Summary	2

C. Table of Contents	4
D. Background Information on the project	5
E. Description of the Property or Affected Environment	6
F. Description of the Geological Setting	7
G. Background to Palaeontology of the area	9
H. Description of the Methodology	10
I. Description of significant fossil occurrences	12
J. Recommendation	12
K. Conclusions	13
L. Bibliography	13
Declaration	13
Appendix 1: Geology of the Transvaal Supergroup	15
Appendix 2: Table	15
Appendix 3: Protocol and Management Plan	15

D. Background information on the project

Report

This report is part of the environmental impact assessment process under the National Environmental Management Act, as amended (Act No. 107 of 1998) (NEMA) and includes Appendix 6 (GN R38282 of 4 December 2014) of the Environmental Impact Assessment Regulations (see Appendix 2).

Outline of development

This report discusses and aims to provide the developer with information regarding the location of palaeontological material that will be impacted by the development. In the pre-construction phase it is necessary for the developer to apply for the relevant permit from the South African Heritage Resources Agency (SAHRA / PHRA).

The applicant, Walkerville Village Mews, proposes to develop the property in to a 'sustainable living' and greener technologies facilities including retirement housing and open spaces.

The design includes:

- Erf 1 - 2: Community Facility,
- Erf 3 - 7: Retirement Housing,
- Erf 8: Living Units,
- Erf 9: Private Open Space, and
- Erf 10: Private Open Space with sewage plant.

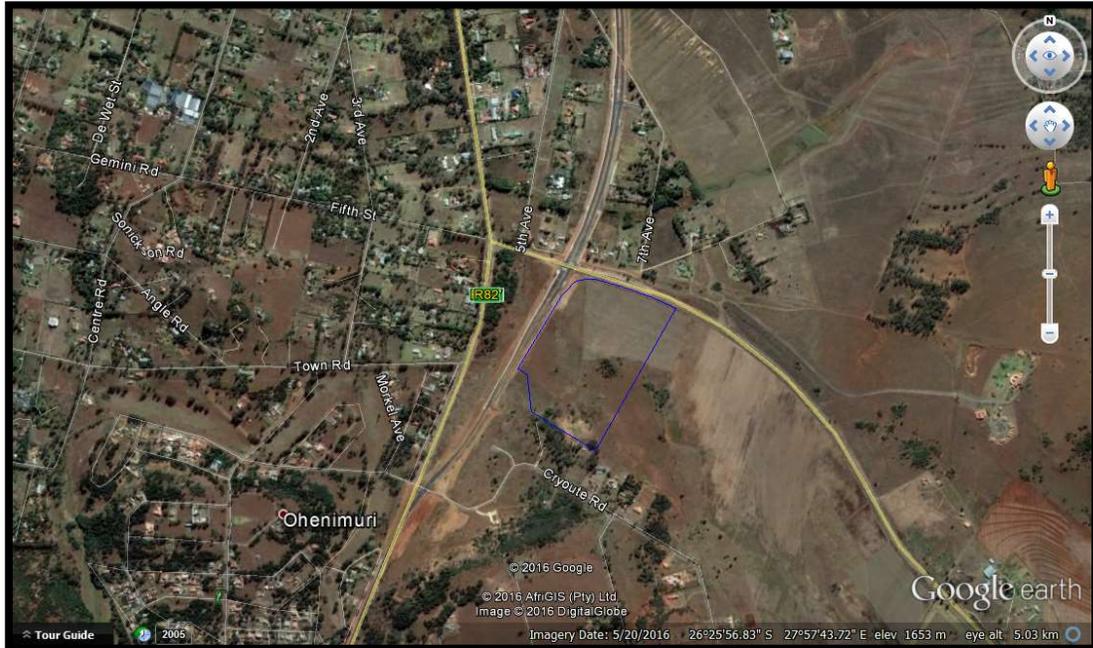
Figure 1: Layout plan of Walkerville Village Mews (ENVIROSYNERGY).

Depth is determined by the related infrastructure.

The Project includes one layout alternative (see google.earth image):

Option 1: A block outlined in blue with the R82 Road as the north-south route which links Vereeniging and Johannesburg via Walkerville, the R557 Road is to the northeast. The site is approximately 19.872 hectares including 4.396 hectares of open space.

Figure 2: Google.earth image showing location.



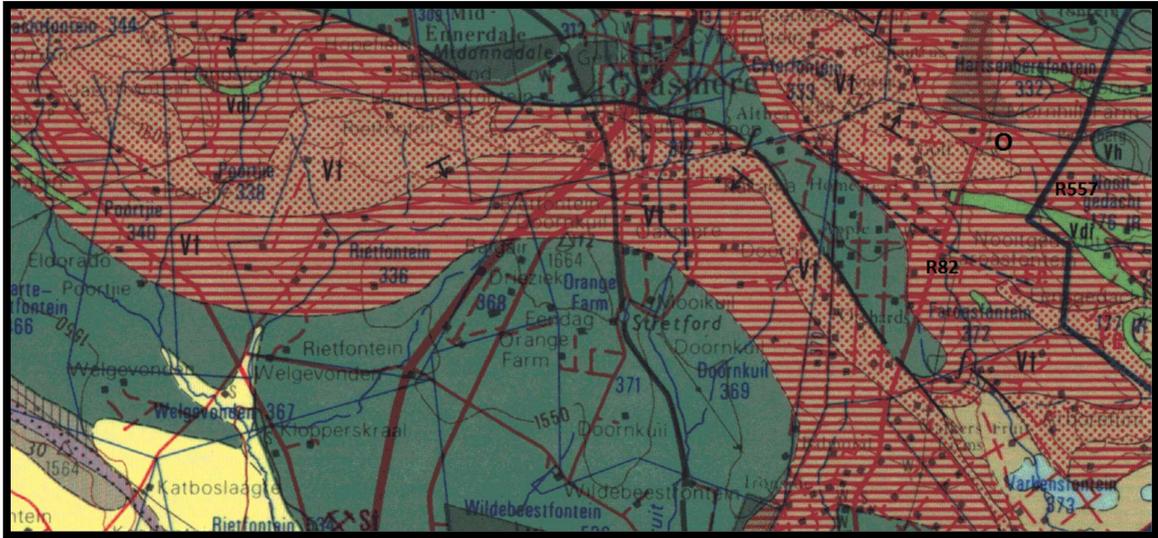
The site is underlain by the Transvaal Supergroup rocks.

F. Description of the Geological Setting

Description of the rock units:

The Transvaal Supergroup fills an east-west elongated basin in the south-central part of the old Transvaal (now North – West, Gauteng and Mpumalanga) as far south as Potchefstroom. It is Vaalian in age, approximately 2600 Ma to 2100 Ma. A maximum thickness of the Transvaal Supergroup reaches 2000 m in the north-eastern section. The east-west elongated basin is filled with clastic, volcanic and chemical sedimentary rocks. Three groups based on lithological differences have been established: they are the Rooiberg, Chuniespoort, and Pretoria Groups as well as other smaller groups (Kent 1980, Snyman 1996). It is the Bushveld Complex that is responsible for the tilting of the Transvaal sediments and the heat of its intrusion having created andalusite crystals (Norman and Whitfield 2006). This Supergroup is underlain by the Ventersdorp, Witwatersrand and Pongola Supergroups, and the Dominion Group. Three prominent ridges are present from the oldest to the youngest, the Time Ball Hill, Daspoort and Magaliesberg Formations (Norman and Whitfield 2006).

Figure 3: Geology of the proposed development area (Keyser 1986)



Legend to Map and short explanation.

Vdi – Diabase (green), Vaalian.

Vh – Andesite, agglomerate, tuff (green), Hekpoort Formation, Pretoria Group, Transvaal Supergroup.

Vt – Ferruginous quartzite [::], ferruginous shale, hornfels [=] (brown), Time Ball Hill Formation, Pretoria Group, Transvaal Supergroup.

---f--- (black) Fault.

⊥ 20 - Strike and dip of bed.

O – Approximate position of Walkerville (circle in black).

The Pretoria Group consists predominantly of quartzite and shale, together with a prominent volcanic unit, minor conglomerate, chemical and volcanic members and overlies the Chuniespoort Group unconformably. The upper contact is with the Bushveld Complex (Eriksson 1999). It comprises the Hekpoort Andesite, Dullstroom Basalt, Time Ball Hill, Silverton, and Magaliesberg Quartzite Formations as well as several smaller formations (in total 15) and overlies the Chuniespoort Group (Kent 1980). Both the shale and quartzite of the Pretoria Group are utilised in the building industry (Snyman 1996). The Time Ball Hill shale Formation is known to contain 'algal microfossils' diagenetic in origin. Stromatolites as they are known are preserved in the subordinate carbonate rocks (Kent 1980). The Pretoria Group is clastic sedimentary in nature (Eriksson 1999). The pile of sedimentary rocks, mainly mudstones and quartzites with some basalt can collectively reach a thickness of up to 5 km.

The Hekpoort Andesite Formation is usually well developed, except for the Mokopane and Thabazimbi regions (Visser 1989) and can be up to 500 m thick with andesite, basalt and pyroclasts. These sheets are massive with an amygdaloidal crust on top (Snyman 1996). It is rich in green hornblende with an age between $2,224 \pm 21$ Ma (2626 Wes Rand sheet info).

Vaalian to post-Mokolian diabase (di) intrusions occur throughout the area in the form of plates, sills and dykes. These plates are common in the Transvaal Supergroup and when present in the Pretoria Group they are referred to as the Transvaal diabase (Kent 1980, Visser 1989). The diabase sills of Bushveld age (Norman and Whitfield 2006) is typically fine-grained, green-grey with plagioclase and pyroxenes (Visser 1989).

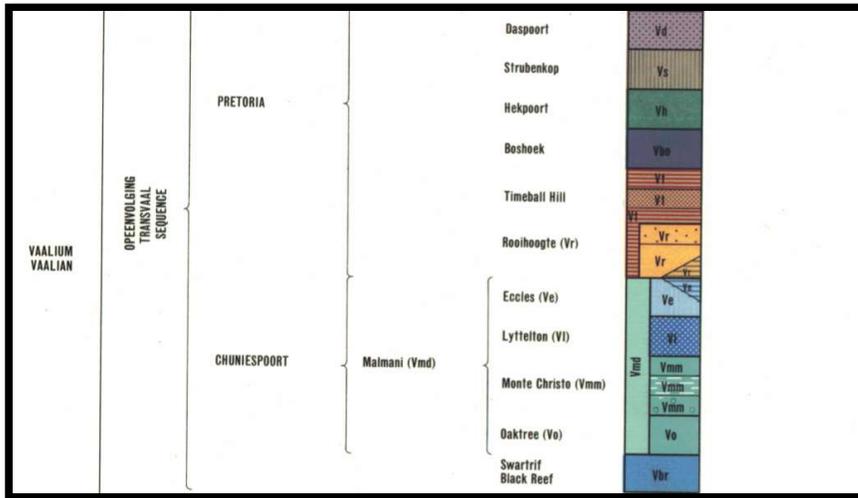
The geological history of the Gauteng Province spans a total of 3600 my including some of the major events that lead to the deposition of a wealth of economically important sequences of rocks (Groenewald and Groenewald 2014). The Hekpoort and Time Ball Hill Formations are present here in the development area that does contain stromatolites.

The Project includes one layout alternative (see google.earth image):

Option 1: A block outlined in blue with the R82 Road as the north-south route which links Vereeniging and Johannesburg via Walkerville, the R557 Road is to the northeast. The site is approximately 19.872 hectares including 4.396 hectares of open space.

A quartzite ridge is present to the north of the site, while the shale forms the low lying areas along the eastern and southern side. The recommendation is that the earthworks will take place to an average depth of 1.0 m. (Arkert 2013).

Figure 4: Lithostratigraphic column of the geology of the site (Keyser 1986).



It is recommended to wait for the response from SAHRA on the Desktop Study (this report), and if a Phase 1: Field study is recommended then SAHRA protocol must be followed. Alternatives will not be feasible.

G. Background to Palaeontology of the area

Summary: 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 (SG 2.2 SAHRA AMPHOB, 2012).

'Algal microfossils' have been reported from the Time Ball Hill Formation shales and are probably of diagenetic origin. Stromatolites are preserved also in the subordinate carbonate rocks of the Pretoria Group (Eriksson 1999). Stromatolites are significant indicators of palaeoenvironments and provide evidence of algal growth between 2640 and 2432 million years ago (Groenewald and Groenewald 2014).

Table 1: Taken from Palaeotechnical Report (Groenewald and Groenewald 2014).

Subgroup/sequence	Group	Formation	Fossil Heritage	Comment
Transvaal Supergroup	Pretoria	Hekpoort Formation (Vh).	None.	-
Transvaal Supergroup	Pretoria	Time Ball Hill Formation (Vt)	Stromatolites	Also contain microfossils. This may also apply to carbonaceous mudrocks

Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity is generally LOW to VERY HIGH, but here locally HIGH for the Pretoria Group including the Time Ball Hill Formation, Transvaal Supergroup.

Table 2: Criteria used (Fossil Heritage Layer Browser/SAHRA):

Rock Unit	Significance/vulnerability	Recommended Action
Pretoria Group	High	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely
Time Ball Hill	High	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely

Hekpoort Formation	Moderate	Desktop study is required
--------------------	----------	---------------------------

Databases and collections: Ditsong: National Museum of Natural History.

Impact: HIGH for the Pretoria Group including the Time Ball Hill Formation, Transvaal Supergroup. There are significant fossil resources that may be impacted by the development and if destroyed are no longer available for scientific research or other public good.

H. Description of the Methodology

The palaeontological impact assessment desktop study was undertaken in November 2016. A literature survey is included and the study relied on literature, geological maps, google.maps and google.earth images.

Assumptions and Limitations (Appendix 6 of Act 1(i):-

The accuracy and reliability of the report may be limited by the following constraints:

1. Most development areas have never been surveyed by a palaeontologist or geophysicist.
2. Variable accuracy of geological maps and associated information.
3. Poor locality information on sheet explanations for geological maps.
4. Lack of published data.
5. Lack of rocky outcrops.
6. Insufficient data from developer and exact lay-out plan for all structures.

A Phase 1 Palaeontological Impact Assessment: Field Study will include:

1. Recommendations for the future of the site.
2. Background information on the project.
3. Description of the property of affected environment with details of the study area.
4. Description of the geological setting and field observations.
5. Background to palaeontology of the area.
6. Field Rating.
7. Stating of Significance (Heritage Value).

A Phase 2 Palaeontological Impact Assessment: Mitigation will include:

1. Recommendations for the future of the site.
2. Description of work done (including number of people and their responsibilities).
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan.
6. Possible declaration as a heritage site or Site Management Plan.

The National Heritage Resources Act No. 25 of 1999 further prescribes.

Act No. 25 of 1999. National Heritage Resources Act, 1999.

National Estate: 3 (2) (f) archaeological and palaeontological sites,

(i)(1) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens,

Heritage assessment criteria and grading: (a) Grade 1: Heritage resources with qualities so exceptional that they are of special national significance;

(b) Grade 11: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and (c) Grade 111: Other heritage resources worthy of conservation.

SAHRA is responsible for the identification and management of Grade 1 heritage resources.

Provincial Heritage Resources Authority (PHRA) identifies and manages Grade 11 heritage resources.

Local authorities identify and manage Grade 111 heritage resources.

No person may damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of a provincially protected place or object without a permit issued by a heritage resources authority or local authority responsible for the provincial protection.

Archaeology, palaeontology and meteorites: Section 35.

(2) Subject to the provisions of subsection (8) (a), all archaeological objects, palaeontological material and meteorites are the property of the State.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ*, and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that:

- (a) the palaeontological resources under threat have been adequately recorded and sampled, and
- (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance.

Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

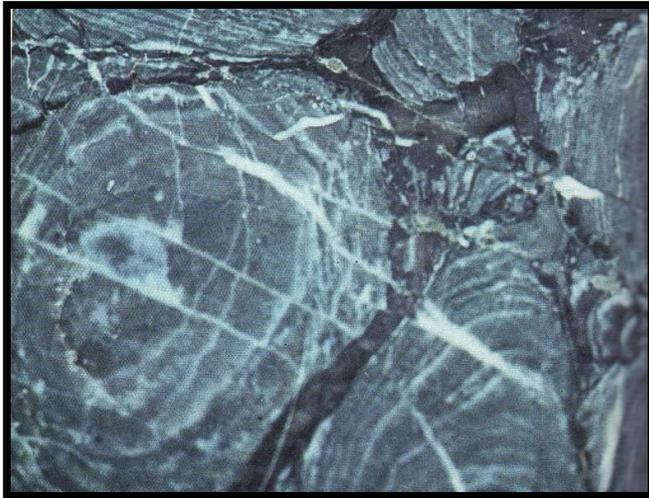
Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

I. Description of significant fossil occurrences

Details of the location and distribution of all significant fossil sites or key fossiliferous rock units are often difficult to determine due to thick topsoil, subsoil, overburden and alluvium. Depth of the overburden may vary a lot.

Stromatolites are likely to be present in the shale. These 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). These are present in the surrounding Time Ball Hill Formation which is underlying the Hekpoort Formation.

Figure 5: Thin section of a stromatolite (De Zanche and Mietto 1977).



The threats are:- earth moving equipment/machinery (front end loaders, excavators, graders, dozers) during construction, the sealing-in or destruction of fossils by development, vehicle traffic, and human disturbance. See Description of the Geological Setting (F) above.

J. Recommendation

- a. There is no objection (see Recommendation B) to the development, it may be necessary to request a Phase 1 Palaeontological Impact Assessment: Field study to determine whether the development will affect fossiliferous outcrops as the palaeontological sensitivity is **HIGH**. A Phase 2 Palaeontological Mitigation may be required if a Phase 1 Palaeontological Assessment identifies a fossiliferous formation (for example breccia). Here caution for the shale is recommended.
- b. This project may benefit the economy, the growth of the community and social development in general.
- c. Preferred choice: The impact on the palaeontological heritage is **HIGH**. Care must be taken during the grading of roads, digging of foundations and removing topsoil, subsoil and overburden (see Executive Summary) or blasting of bedrock.
- d. The following should be conserved: if any palaeontological material is exposed during digging, excavating, drilling or blasting SAHRA must be notified. All construction activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures.

Sampling and collecting:

Wherefore a permit is needed from the South African Heritage Resources Agency (SAHRA / PHRA).

- a. Objections: Cautious. See heritage value and recommendation.
- b. Conditions of development: See Recommendation.
- c. Areas that may need a permit: **Yes**.
- d. Permits for mitigation: Needed from SAHRA/PHRA prior to Mitigation.

K. Conclusions

- a. All the land involved in the development was assessed and none of the property is unsuitable for development (see Recommendation B).
- b. All information needed for the Desktop study was provided by the Environmental Consultant. All technical information was provided by ENVIROSYNERGY CONSULTING.
- c. Areas that would involve mitigation and may need a permit from the South African Heritage Resources Agency are discussed.
- d. The following should be conserved: if any palaeontological material is exposed during digging, excavating, drilling or blasting, SAHRA must be notified. All development activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures, for example, shallow caves.

- e. Condition in which development may proceed: It is further suggested that a Section 37(2) agreement of the Occupational, Health and Safety Act 85 of 1993 is signed with the relevant contractors to protect the environment and adjacent areas as well as for safety and security reasons.

L. Bibliography

- ALMOND, J., PETHER, J, and GROENEWALD, G. 2013. South African National Fossil Sensitivity Map. SAHRA and Council for Geosciences.
- ARKERT, J.K.A. 2013. Engineering Geological Investigation Report on the Remaining Extent of Portion 174 of the Farm Faroasfontein 372-IQ, Walkerville. Africa Exposed Consulting Engineering Geologists, Pp 1-5.
- DE ZANCHE, V. and MIETTO, P. 1977. *The World of Fossils*. Sampson Low Guides, Berkshire, Printed in Italy, Pp 256.
- ERIKSSON, P.G. 1999. Pretoria Group [Transvaal Supergroup]. Catalogue of South African Lithostratigraphic Units. South African Committee for Stratigraphy, **6**: 29-32.
- GROENEWALD, G. and GROENEWALD, D. 2014. SAHRA Palaeotechnical Report: Palaeontological Heritage of Gauteng. South African Heritage Resources Agency, Pp 1-20.
- KENT, L. E., 1980. Part 1: Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia and the Republics of Bophuthatswana, Transkei and Venda. SACS, Council for Geosciences, *Stratigraphy of South Africa. 1980. South African Committee for Stratigraphy. Handbook 8, Part 1*, Pp 690.
- KEYSER, N.1986. Geological Map 2626 Wes Rand, 1:250 000. South African Committee for Stratigraphy, Council for Geoscience, Pretoria.
- 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. 2013. *Geology off the beaten track: exploring South Africa's hidden treasures*. De Beers, Struik, Pp 1-256.
- NORMAN, N. and WHITFIELD, G., 2006. *Geological Journeys*. De Beers, Struik, Pp 1-320.
- SG 2.2 SAHRA APMHOB Guidelines, 2012. Minimum standards for palaeontological components of Heritage Impact Assessment Reports, Pp 1-15.
- SNYMAN, C. P., 1996. *Geologie vir Suid-Afrika*. Departement Geologie, Universiteit van Pretoria, Pretoria, Volume 1, Pp. 513.
- VAN DER WALT, M., DAY, M., RUBIDGE, B. S., COOPER, A. K. & NETTERBERG, I., 2010. Utilising GIS technology to create a biozone map for the Beaufort Group (Karoo Supergroup) of South Africa. *Palaeontologia Africana*, **45**: 1-5.
- VISSER, D.J.L. (ed) 1984. Geological Map of South Africa 1:100 000. South African Committee for Stratigraphy. Council for Geoscience, Pretoria.
- VISSER, D.J.L. (ed) 1989. *Toeligting: Geologiese kaart (1:100 000). Die Geologie van die Republieke van Suid Afrika, Transkei, Bophuthatswana, Venda, Ciskei en die Koningryke van Lesotho en Swaziland*. South African Committee for Stratigraphy. Council for Geoscience, Pretoria, Pp 494.

Declaration / disclaimer

I, Heidi Fourie, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project for which I was appointed to do a palaeontological assessment. There are no circumstances that compromise the objectivity of me performing such work.

I accept no liability, and the client, by receiving this document, indemnifies me against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the use of the information contained in this document.

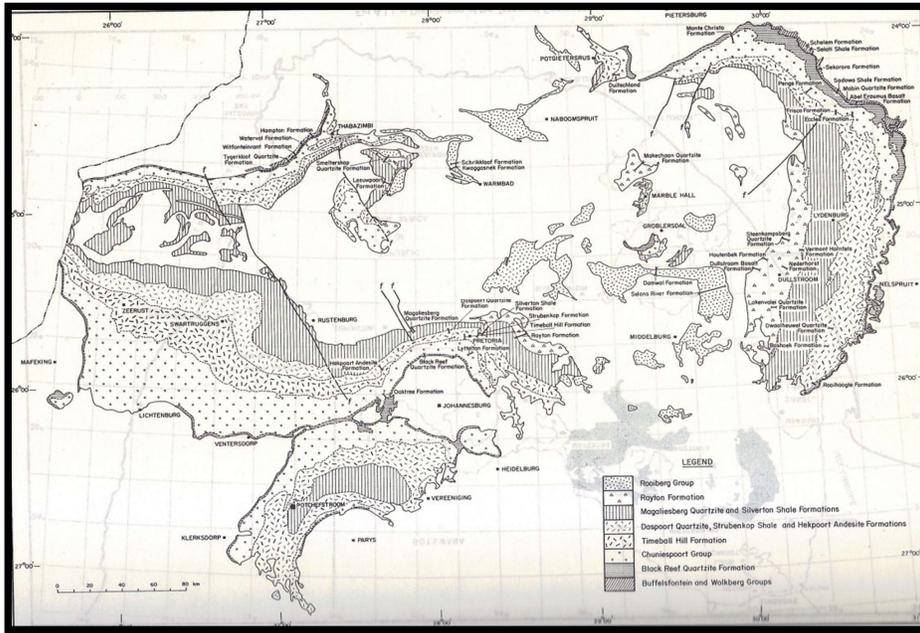
It may be possible that the desktop study may have missed palaeontological resources in the Project Area as the presence of outcrops are not known and may only be found once development commences.

This report may not be altered in any way and any parts drawn from this report must make reference to this report.



Heidi Fourie
2016/11/11

Appendix 1: Geology of the Transvaal Supergroup (Kent 1980).



Appendix 2:

Table 3: Listing points in Appendix 6 of the Act and position in Report.

Section	Point in Act	Heading
B	1(c)	Outline of development project
	1(d)	Summary of findings
	1(g)	Concerns/threats:
	1(n)i	"
	1(n)ii	"
	1(o)	"
	1(p)	"
D	1(h)	Figures
	1(a)i	Terms of reference
H	1(e)	Description of Methodology
	1(i)	Assumptions and Limitations
I	1(f)	Heritage value
J	1(j)	Recommendation
	1(l)	"
	1(m)	Sampling and collecting
	1(k)	"
Declaration	1(b)	Declaration
Appendix 1	1(k)	Protocol for finds
	1(m)	"
	1(q)	"

Appendix 3: Protocol for Finds and Management Plan.

This section covers the recommended protocol for a Phase 2 Mitigation process as well as for reports where the Palaeontological Sensitivity is LOW or HIGH; this process guides the palaeontologist / palaeobotanist on site and should not be attempted by the layman / developer.

The developer must survey the areas affected by the development and then indicate on plan where the construction / development / mining will take place. Trenches have to be dug to ascertain how deep the sediments are above the bedrock (can be a few hundred metres). This will give an indication of the depth of the topsoil, subsoil, and overburden, if need be trenches should be dug deeper to expose the interburden.

Mitigation will involve recording, rescue and judicious sampling of the fossil material present in the layers sandwiched between the geological / coal layers. It must include information on number of taxa, fossil abundance, preservational style, and taphonomy. This can only be done during excavations. In order for this to happen, in case of mining operations, the process will have to be closely scrutinised by a professional palaeontologist / palaeobotanist to ensure that only the coal layers are mined and the interlayers (siltstone and mudstone) are surveyed for fossils or representative sampling of fossils are taking place.

The palaeontological impact assessment process presents an opportunity for identification, access and possibly salvage of fossils and add to the few good plant localities. Mitigation can provide valuable onsite research that can benefit both the community and the palaeontological fraternity.

A Phase 2 study is very often the last opportunity we will ever have to record the fossil heritage within the development area. Fossils excavated will be stored at a National Repository.

A Phase 2 Palaeontological Impact Assessment: Mitigation will include (SAHRA) -

1. Recommendations for the future of the site.
2. Description and purpose of work done (including number of people and their responsibilities).
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan and map.
6. Possible declaration as a heritage site or Site Management Plan.
7. Stakeholders.
8. Detailed report including the Desktop and Phase 1 study information.
9. Annual interim or progress Phase 2 permit reports as well as the final report.
10. Methodology used.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ*, and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

The Palaeontological Society of South Africa (PSSA) does not have guidelines on excavating or collecting, but the following is suggested:

1. The developer needs to clearly stake or peg-out (survey) the areas affected by the mining / construction / development operations and dig representative trenches and if possible supply geological borehole data.
2. Fossils likely to occur are for example the fossil plants from the Vryheid Formation, these are present in the grey shale (or any other fossiliferous layer ranked VERY HIGH or HIGH) or invertebrates from the Volksrust Formation.
3. When clearing topsoil, subsoil or overburden and hard rock (outcrop) is found, the contractor needs to stop all work.
4. A Palaeontologist / Palaeobotanist (contact SAHRIS for list) must then inspect the affected areas and trenches for fossiliferous outcrops / layers. The contractor / developer may be asked to move structures, and put the development on hold.
5. If the Palaeontologist / Palaeobotanist is satisfied that no fossils will be destroyed or have removed fossils, development and removing of the topsoil can continue.
6. After this process the same Palaeontologist / Palaeobotanist will have to inspect and offer advice through the Phase 2 Mitigation Process. Bedrock excavations for footings may expose, damage or destroy previously buried fossil material and must be inspected.
7. When permission for the development is granted, the next layer can be removed, if this is part of the Vryheid Formation, then with the removal of each layer of sediment, the Palaeontologist / Palaeobotanist must do an investigation (a minimum of once every week).
8. At this stage the Palaeontologist / Palaeobotanist in consultation with the developer / mining company must ensure that a further working protocol and schedule is in place. Onsite training should take place, followed by an annual visit by the Palaeontologist / Palaeobotanist.

Fossil excavation if necessary during Phase 2:

1. Photography of fossil / fossil layer and surrounding strata.
2. Once a fossil has been identified as such, the task of extraction begins.
3. It usually entails the taking of a GPS reading and recording lithostratigraphic, biostratigraphic, date, collector and locality information.
4. Using Paraloid (B-72) as an adhesive and protective glue, parts of the fossil can be kept together (not necessarily applicable to plant fossils).
5. Slowly chipping away of matrix surrounding the fossil using a geological pick, brushes and chisels.
6. Once the full extent of the fossil / fossils is visible, it can be covered with a plaster jacket (not necessarily applicable to plant fossils).
7. Chipping away sides to loosen underside.
8. Splitting of the rock containing palaeobotanical material will reveal any fossils sandwiched between the layers.

This document forms part of the Environmental Monitoring Programme. For practical reasons a palaeontologist may only be required to be on site once a week. If any fossil material is discovered then a Phase 2 rescue operation might be necessary, and a permit will be needed.

SAHRA has the following documents in place:

Guidelines to Palaeontological Permitting policy.

Minimum Standards: Palaeontological Component of Heritage Impact Assessment reports.

Guidelines for Field Reports.

Palaeontological Heritage Reports (All Provinces).