Proposed Hazia Filling Station Project

Ramotshere Moiloa Local Municipality, North West Province

Farm: Portion 24 (a Portion of Portion 5) of the farm Hazia 240JP

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Palaeontological Impact Assessment: Addendum

Facilitated by: Setala Environmental

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2017/07/24

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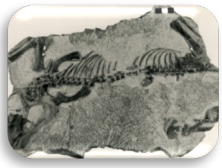


B. Executive summary

Outline of the development project: Setala Environmental 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 Hazia Filling station Project, with related infrastructure on Portion 24 (a Portion of Portion 5) of the farm Hazia 240 JP in the Ramothshere Moiloa Local Municipality, North West Province. The request for the study came from SAHRA's interim comment on the EIA Application. It was requested that the Palaeontological Specialist study be revised to address the following concerns:

- The depth of the excavations for the foundations of the development must be taken into account for the impact assessment (Page 5).
- There must be a discussion of the Quaternary soil layer and the potential fossils it may contain, as well as the highly sensitive formations below the Time Ball Hill formation (Page 7- 8).
- The highly sensitive areas must be mapped out in detail by the PIA specialist, using the geological map (refer to (Table 2).
- Clear recommendations for mitigation of impacts must be provided by the specialist (Page 4).

This is an addendum to the Desktop Study.

The applicant, Munghana Leisure and Tourism (Ltd), proposes to develop the property in to a filling station with related infrastructure in Zeerust.

This addendum aims to provide comment and recommendation 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.

The Project includes one Option (see google.earth image):
Option 1: A block outlined in black bound by the N4, the Kareespruit, Portion 56 of Hazia 240 JP and Rudolf Street to the north, River Avenue and the Klein-Marico River to the east, a Rail Way Line on Portion 48 of Hazia 240 JP to the south, and Kloof Street to the west. The site is approximately 28 hectares.

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 (2526) Geological Map of Rustenburg (Walraven 1981).

Figure 1: The geology of the development area.

Legend to Map and short explanation.

m – Alluvium (yellow), Quaternary.
di – Diabase, hybrid diabase [::] (green), Vaalian.
Vha – Andesite, basalt, agglomerate, tuff, shale, chert (green), Hekpoort Formation, Pretoria Group, Transvaal Supergroup.
Vt – Ferruginous quartzite [::], shale, slate, with andalusite (brown), Time Ball Hill Formation, Pretoria Group, Transvaal Supergroup.
Vmf – Dark chert-free dolomite, locally with tremolite, light stromatolitic [::], shale [=], tuff (blue), Frisco Formation, Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup.
---f--- – (black) Fault.
⊥ 20 - Strike and dip of bed.
□ – Approximate footprint of proposed mall / filling station.

Mining Activities

AA – Amosite asbestos	An – Andalusite	F – Fluorspar
Fe – Iron	Ls – Limestone, dolomite	Mn – Manganese
Pb - Lead		

Summary of findings: The Palaeontological Impact Assessment: Desktop study was undertaken in September 2016 and March 2017 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 Formation of the Pretoria Group, Transvaal Supergroup, but mostly on the intrusive diabase. The site is 28 ha and is disturbed by brick works and the back-fill of an old quarry.

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.

Over areas totalling fully 40% of Southern Africa the 'hard rocks', from the oldest to the Quaternary, are concealed by normally unconformable deposits – principally sand, gravel, sandstone, and limestone. Inland deposits are much more extensive than marine deposits and are terrestrial and usually unfossiliferous. Some of these deposits date back well into the Tertiary, whereas others are still accumulating. Owing to the all-to-often lack of fossils and of rocks suitable for radiometric or palaeomagnetic dating, no clear-cut dividing line between the Tertiary and Quaternary successions could be established (Kent 1980). The alluvium sands were deposited by a river system and reworked by wind action (Snyman 1996).

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).

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, **MEDIUM** for the Quaternary and **VERY LOW** for the diabase (SG 2.2 SAHRA APMHOB, 2012).

Recommendation:
The impact of the development on fossil heritage is **HIGH, MEDIUM and VERY LOW** and therefore a field survey or further mitigation or conservation measures may be necessary for this development (according to SAHRA protocol) if a fossil is found. A Phase 2 Palaeontological Impact Assessment and or mitigation may then be recommended.

The comments on the palaeontological review are;

- The site has previously been used for brick making purposes and has been disturbed.
- Outcrops of the Time Ball Hill Formation will be scarce. Outcrops of alluvium will not be disturbed due to the 1:100 and 1: 50 year flood lines, except for the roads, services and parking areas, but these are protected by the EMPr.
- As part of the Environmental Authorisation conditions, an Environmental Control Officer (ECO) will be appointed to oversee the construction activities in line with legally binding Environmental Management Programme (EMPr).
- The EMPr already covers the conservation of heritage and palaeontological artefacts that may be exposed during construction activities. The protocol is to immediately cease all construction activities if a fossil is unearthed and contact SAHRA for further investigation. It is recommended that the EMPr be updated to include the involvement of a palaeontologist during the digging and excavation phase of the development.

Concerns/threats (1g,1ni,1nii,1o,1p):

1. Threats are earth moving equipment/machinery (front end loaders, excavators, graders, dozers) during construction, digging of foundations, the sealing-in, disturbance, damage or destruction of the fossils by development, vehicle traffic and human disturbance.
2. 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.
3. Mitigation is not needed, permit needed from SAHRA if a fossil is found.
4. No consultation with parties was necessary.
5. The development may go ahead with caution, the Environmental Control Officer must familiarise him- or herself with the Time Ball Hill Formation (Nixon *et al.* 1988) and quaternary alluvium. If a fossil is found during construction, construction must stop, the area must be fenced off and SAHRA/PHRA must be notified (Protocol for Finds and Management Plan is attached).

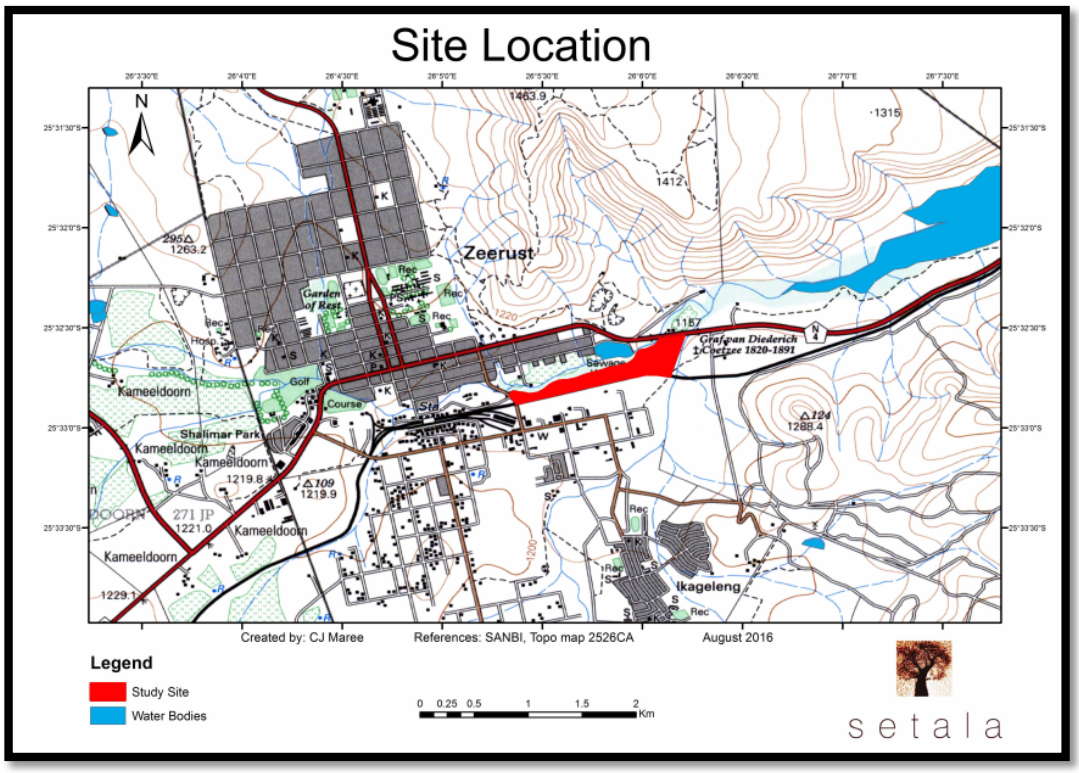
Stakeholders:
Developer of the total site– Akani Properties Pty (Ltd) – 7 Disa Road, Kempton Park, 1619, Tel. 011 578 5333.
Developer of the filling station site - Munghana Leisure and Tourism Pty (Ltd)
Environmental – Setala Environmental, P.O. Box 36593, Menlo Park, 0102, Tel. 012 361 5763.
Landowner – Zeerust Modern Bricks Pty (Ltd) – Private Bag x36, Kempton Park, 1620, Tel. 011 578 5333.

C. Background information on the project
Outline of development
The applicant, Munghana Leisure and Tourism Pty (Ltd), proposes to develop a portion of the bigger property in to and filling station with related infrastructure in Zeerust. This will aid in economic development to promote economic growth and creation of job opportunities.

The Klein Marico River forms the eastern boundary, a second river bounds the site on the north and northwest, the Spoornet Railway line and servitude forms the southern boundary and the tarred road to Ikageleng Township is to the west. The site

had previously been used for the manufacturing of bricks, has been stripped of vegetation, and an old quarry exists which had been partly back-filled with waste form the brick factory. A sewer line is also present.

Figure 2: Topographic map showing location of the total site (Setala Environmental).



The following infrastructure is anticipated:

1. Buildings,
2. Parking areas,
3. Roads,
4. Water services,
5. Sewerage services,
6. And associated infrastructure such as electricity lines.

The Project includes one Option (see google.earth image):
Option 1: A block outlined in black bound by the N4, the Kareespruit, Portion 56 of Hazia 240 JP and Rudolf Street to the north, River Avenue and the Klein-Marico River to the east, a Rail Way Line on Portion 48 of Hazia 240 JP to the south, and Kloof Street to the west. The site is approximately 28 hectares.

D. Description of property or affected environment

Location and depth:

An area bound by the N4, the Kareespruit, Portion 56 of Hazia 240 JP and Rudolf Street to the north, River Avenue and the Klein-Marico River to the east, a Rail Way Line on Portion 48 of Hazia 240 JP to the south, and Kloof Street to the west. The site is approximately 28 hectares.

Figure 3: Google.earth image showing location of the total site (Setala Environmental).

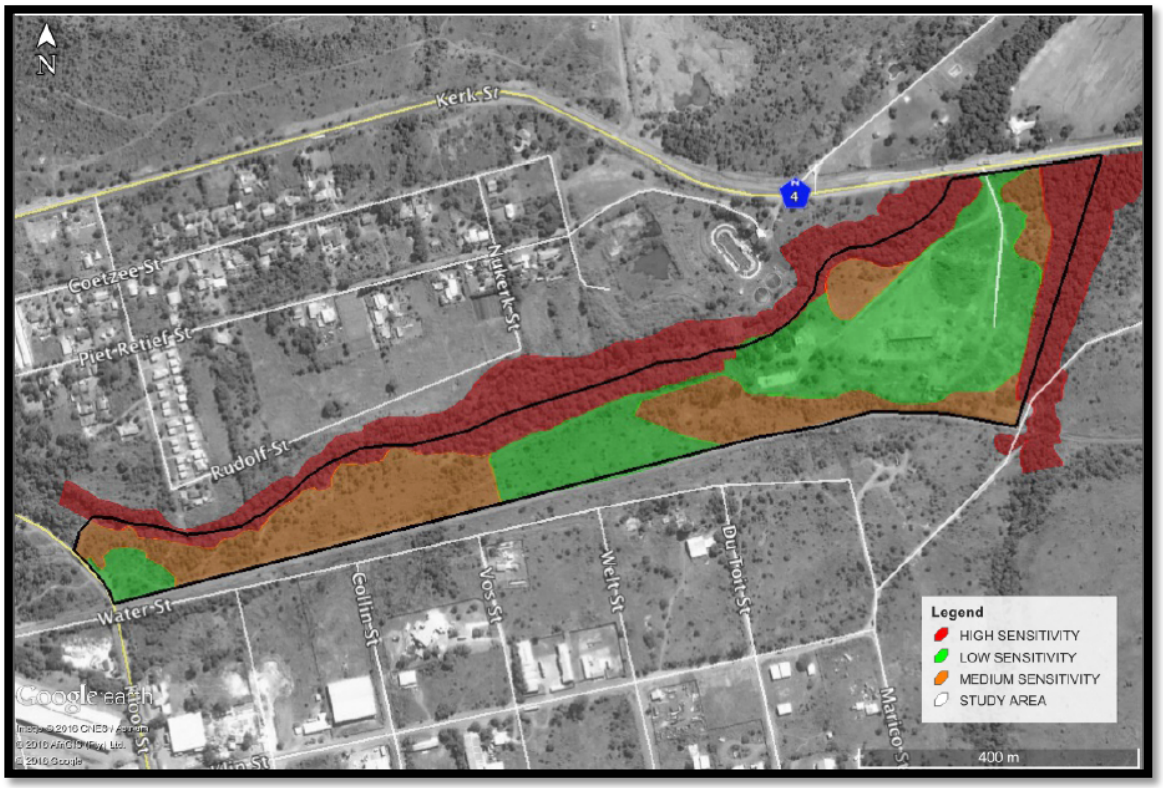


Figure 4: Topographic map showing location of the site for the filling station (Setala Environmental).

The total site is underlain by the Transvaal Supergroup rocks and intrusive diabase.

The Geotechnical Report has detailed information on the trenches dug and soil types present that can be consulted to check on the depth of the remaining Time Ball Hill outcrops. Kent (1980) does not indicate a depth or thickness for the Time Ball Hill Formation as it is a hill in the City of Tshwane. Depth will be determined by the foundations.

E. 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).

The geological history of the North West 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. The more recent Phanerozoic deposits are of importance in the study of the evolution of life during the last 300 million years. Large areas in the western part of the Province are underlain by Cenozoic deposits of the Kalahari Group (Groenewald and Groenewald 2014). The Time Ball Hill Formations is present here in the development area with its characteristic stromatolites.

'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. None of these fossils have been described from the ancient rocks in the North West Province, and as such, any recording of these organisms will be significant (Groenewald and Groenewald 2014).

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

Over areas totalling fully 40% of Southern Africa the 'hard rocks', from the oldest to the Quaternary, are concealed by normally unconformable deposits – principally sand, gravel, sandstone, and limestone. Inland deposits are much more extensive than marine deposits and are terrestrial and usually unfossiliferous. Some of these deposits date back well into the Tertiary, whereas others are still accumulating. Owing to the all-to-often lack of fossils and of rocks suitable for radiometric or palaeomagnetic dating, no clear-cut dividing line between the Tertiary and Quaternary successions could be established (Kent 1980). The alluvium sands were deposited by a river system and reworked by wind action (Snyman 1996). The development does not encroach or overlap on the alluvium sands. Groenewald and Groenewald 2014 described these as alluvial deposits associated with recent water courses of main rivers and streams. These sediments are presently not well studied and records of fossil occurrences are mainly associated with archaeological reports. The Geotechnical Report describes the Time Ball Hill Formation; a thick diabase sill; residual and transported soils; and a thick layer of clayey alluvium that contains variable amounts of rounded gravel only on the flatter northern portion of the site associated with the flood plains of the two rivers. These floodplains are protected by the 1:100 and 1:50 year flood lines that cannot be intruded during construction, except for the roads, services and parking areas.

Fossils will be present in caves, calc tufa and pans and examples are a wide range of mammalian bones and teeth, tortoise remains, ostrich egg, non-marine mollusc shells, ostracods, diatoms, other micro fossils, trace fossils, stromatolites, plant remains and wood (Groenewald and Groenewald 2014).

[Final Report: Geotechnical Investigation for proposed autumn Leaf Mall in Zeerust, North West Province – M.J. van der Walt Engineering, 3/2017]

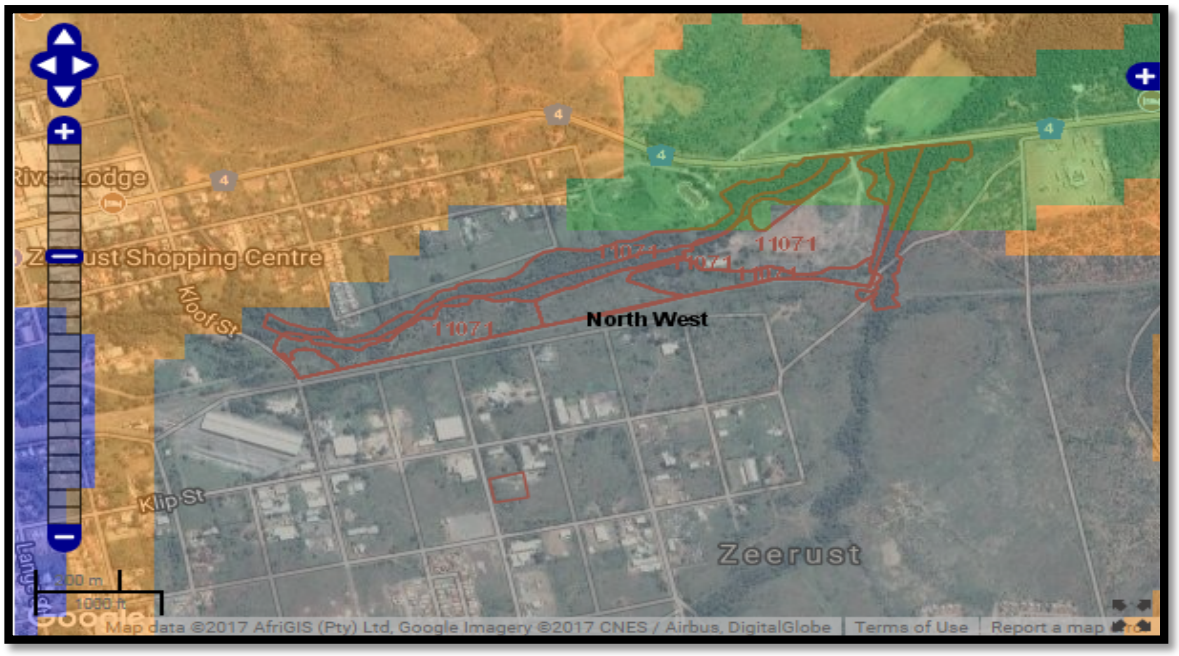
Table 1: Taken from Palaeotechnical Report (Groenewald and Groenewald 2014).

Subgroup/ sequence	Group	Formation	Fossil Heritage	Comment
Quaternary	-	-	Often sparse	Very wide range of possible fossil remains, mammalian bones and teeth, tortoise remains, ostrich egg shell.
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, **MEDIUM** for the Quaternary and **VERY LOW** for the diabase.

Table 2: Criteria used (Fossil Heritage Layer Browser/SAHRA): H–Orange, M–Green, VL-Grey on map below.

Rock Unit	Significance/vulnerability	Recommended Action	Colour coded on map
Quaternary	Medium	Desktop study required	Green
Pretoria Group	High	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely	Orange
Time Ball Hill	High	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely	Orange
Diabase	Insignificant or Zero (Very Low)	No study	Grey

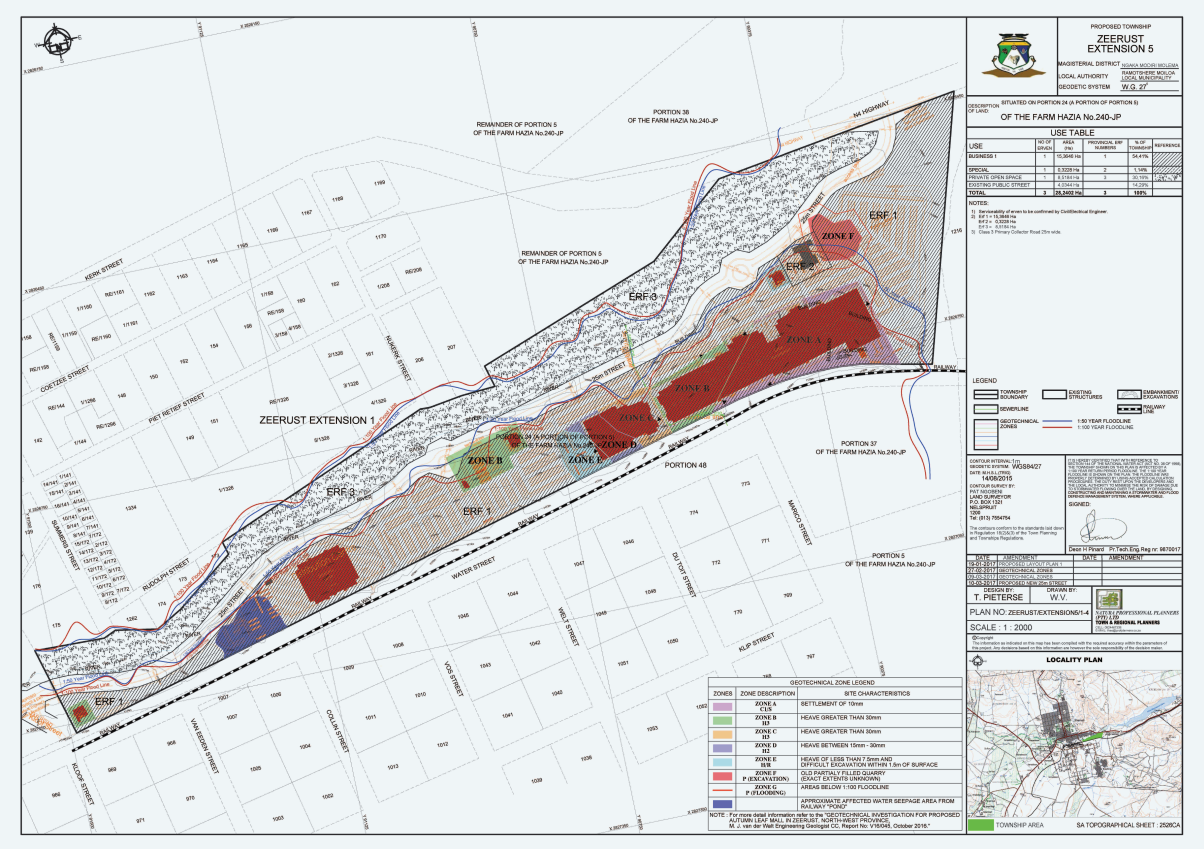


Databases and collections: Ditsong: National Museum of Natural History.

Impact: **HIGH** for the Pretoria Group including the Time Ball Hill Formation, Transvaal Supergroup and **MEDIUM** for the Quaternary. There may be significant fossil resources that may be impacted by the development and if destroyed are no longer available for scientific research or other public good. Most of the total site has a **VERY LOW** sensitivity due to the diabase intrusion (colour coded in grey). From the map above it is evident that the Quaternary soil layer is present in a section at the entrance to the site. This area has medium sensitivity, however as is evident on the Site Development Plan below (Figure 6), this section of the site is below the 1:100 year flood line and no development will be allowed in the flood line areas except for roads and parking areas**.** It is therefore expected that impact to the Quaternary soil layer will be minimal. In addition to the above, the filling station site is mostly located on the diabase intrusion. Refer to Figure 5 below.

Figure 5: Sensitivity map map showing location of the site for the filling station (Setala Environmental).

Figure 6: Site Development Plan (Setala Environmental).



F. Description of the Methodology (1e)

The palaeontological impact assessment desktop study was undertaken in September 2016 and March 2017. 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.

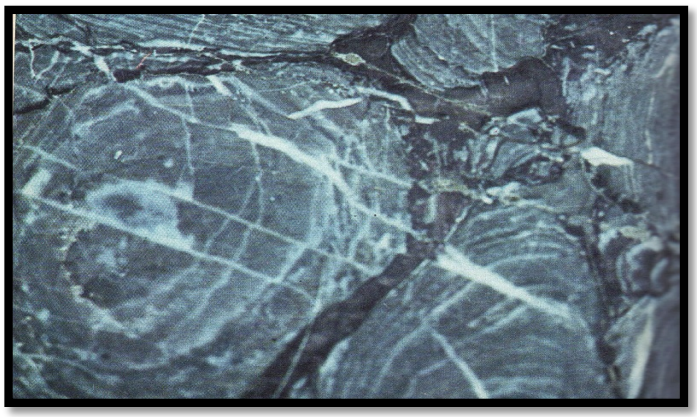
Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

G. Description of significant fossil occurrences (1f)

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. 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 which is devoid of fossils.

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.

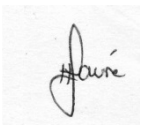
Declaration / Disclaimer (1b)

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.

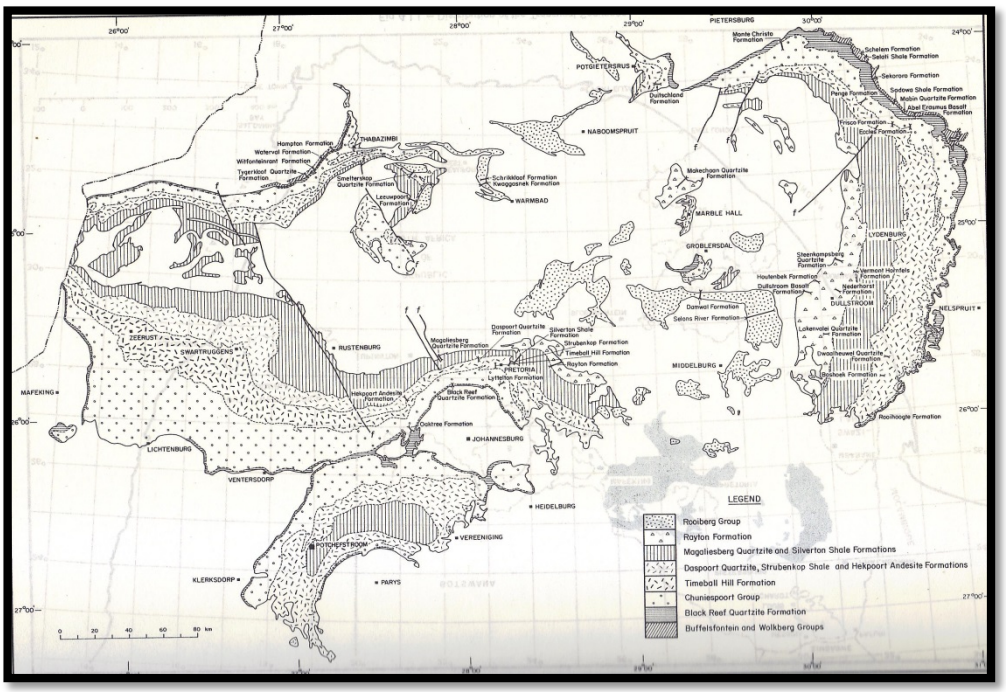
It may be possible that the addendum may have missed palaeontological resources in the Project Area as the presence of outcrops are not known and may only be found once development commences.

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



Heidi Fourie
2017/07/24

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**; this process guides the palaeontologist / palaeobotanist / ECO on site and should not be attempted by the layman / developer. The developer needs to employ an Environmental Control Officer (ECO) to oversee the construction activities so that when a fossil is unearthed they can notify the relevant department and specialist to further investigate. The ECO should familiarise him- or herself with the applicable formations and its fossils. The Evolutionary Studies Institute, University of the Witwatersrand has good examples of fossils.

As part of the Environmental Authorisation conditions, an Environmental Control Officer (ECO) will be appointed to oversee the construction activities in line with legally binding Environmental Management Programme (EMPr). The EMPr already covers the conservation of heritage and palaeontological artefacts that may be exposed during construction activities. The protocol is to immediately cease all construction activities and contact SAHRA for further investigation. It is recommended that the EMPr be updated to include the involvement of a palaeontologist during the digging and excavation phase of the development.

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.

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; see Report, or any other fossiliferous layer ranked **VERY HIGH or HIGH**.
3. When clearing topsoil, subsoil or overburden and hard rock (outcrop) is found, the contractor needs to stop all work. The area needs to be fenced off.
4. A Palaeontologist / Palaeobotanist (contact SAHRIS for list) / ECO 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 / ECO are 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 /ECO 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 Documents:
Guidelines to Palaeontological Permiting policy.
Minimum Standards: Palaeontological Component of Heritage Impact Assessment reports.
Guidelines for Field Reports.
Palaeontological Heritage Reports (All Provinces).