Palaeontological Impact Assessment for the proposed bulk water and sewer pipelines, Hammanskraal West Ext 10

Desktop Study

For

TGM Environmental Services

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Expertise of Specialist

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Experience: 40 years in the fields of geology and palaeontology.

Declaration of Independence

This report has been compiled by Mr. Chris Jones, independent palaeontologist, sub contracted by TGM Environmental Services. The views expressed in this report are entirely those of the author.

Specialist: Mr Chris Jones

Signature

Executive Summary

A Palaeontological Impact Assessment was requested for the proposed bulk water and sewer pipelines to be constructed to the north and west of Hammanskraal, Gauteng Province. To comply with the South African Heritage Resources Agency (SAHRA), in terms of 38(8) of the National Heritage Act. 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed work.

The geology of the area for the proposed construction consists of shales and carbonaceous mudstones of the Hammanskraal Formation, the Permian age Ecca Group, of the Karoo Supergroup, in the Springbok Flats Basin. This is coloured orange / yellow on the SAHRA palaeontological sensitivity map, requiring a desktop study. Based on the outcome of the desktop study, a field assessment is likely. The area is rich in invertebrate fossils and plant remains.

Background

A proposed provision of bulk services (water and sewage) to the Hammanskraal West area entails the construction of two pipes. The section traversed by the proposed pipelines is included in this palaeontology report.

To comply with the South African Heritage Resource 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 project.

Method and Terms of Reference

The terms of reference 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 terms of reference included:

1. Consultation of the 1:250 000 geological map 2528 (Pretoria), literature review, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected area;
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*);
4. Determination of the representivity or scientific importance of the fossils to decide whether they can be destroyed or a representative sample collected (*not applicable to this assessment*).

Legislative Background

The NHRA provides for the setting up of Provincial Heritage Resources Agencies (PHRAs) to manage most aspects of fossil heritage including, for example, permits and database management. However, some key issues (such as export and destruction permits) are dealt with at a national level by SAHRA, based in Cape Town.

The categories of heritage resources falling under Section 3 of the National Heritage Resources Act (1999), include, but are not restricted to:

1. Geological sites of scientific and cultural importance.
2. Palaeontological sites.
3. Palaeontological objects and material, meteorites and rare geological specimens.

Section 35 of this Act states:

1. The protection of archaeological and palaeontological sites and material, and meteorites is the responsibility of a provincial heritage resources authority.
2. 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.
4. No person may, without a permit issued by the responsible heritage resources authority may:
   (a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
   (b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object, or any meteorite;
   (c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite, or
   (d) bring into, or use at an archaeological or palaeontological site any excavation equipment, or any equipment which assist in the detection or recovery of metals or

archaeological and palaeontological material or objects, or use such equipment in the recovery of meteorites.

5. When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted, and no heritage resources management procedure in terms of section 38 has been followed, it may:
   (a) serve on the owner or occupier of the site, or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
   (b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;
   (c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
   (d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

Karoo Geology

The Karoo Supergroup consists of a sequence of mainly terrestrial rocks. Sedimentation took place in the main basin and several smaller basins on the supercontinent of Gondwana, between about 500 and 180 million years ago. The earliest sediments were glacial, due to the then close proximity of the South Pole. The palaeoenvironment became warmer and drier through geological time, from glacial marine, lacustrine, fluvial to aeolian. At the end of Karoo times, sedimentation was abruptly halted by the onset of volcanism, heralding the breakup of Gondwana. The Karoo Supergroup represents an almost unbroken sedimentary record, documenting the emergence and evolution of dinosaurs, unique plant assemblages and terrestrial invertebrates, is host to major coal deposits, and witness to the End Permian Mass Extinction event. Therefore the Karoo rocks are of great economic, geological and palaeontological importance. The main Karoo Basin covers an area of some 700,000 km^2, but its extent was probably considerably larger during Permian times. Smaller depositaries include the Kalahari, Ellisras, Tuli and Springbok Flats Basins as shown in Figure 1 below.

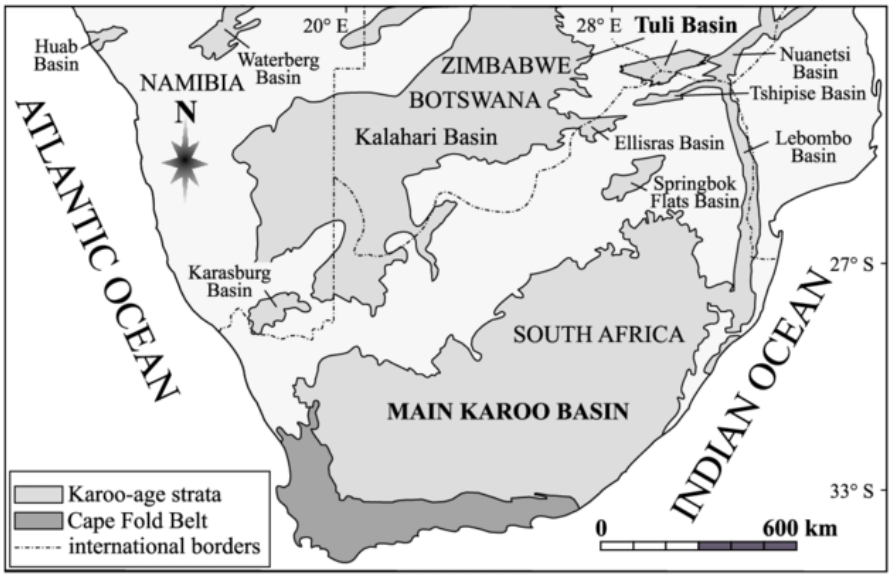

Figure 1: Karoo Basins in southern Africa

Stratigraphic unit	Lithology	Interpreted palaeoenvironment	Fossils present
Breakup of Gondwana			
Drakensberg Group	Tholiitic basalt	Volcanic	Playa lake assemblages in rare pockets of aeolian sand at the base.
Molteno, Elliot and Clarens Formations "Stormberg Series"	Sandstone	Ephemeral rivers, playa lakes, with true desert conditions in the Clarens Formation.	*Massospondylus, Euskelosaurus* (dinosaurs) with playa lake assemblages of fish and crustaceans.
Beaufort Group	Fine to coarse sandstone, siltstone and conglomerates.	Fluvial. Braided to meandering rivers.	Therapsids, including 8 fossil assemblage zones. Dicroidium (plant).
Ecca Group	Sandstone, siltstone, mudrock, limestone, coals.	Marine, lacustrine, deltaic and fluvial. Major swamps.	*Glossopteris* (coal measure plant), mesosaurid reptiles, bivalves, brachiopods, crustaceans.
Dwyka Group	Glacial diamictites.	Glacial marine outwash to the south, highland (mainly erosive) glacial to the north.	Fossil wood, *Glossopteris*, *Dadoxylon*,

			various trace fossils.
Cape Supergroup rocks in the south. Archaean Basement to the north.			

Table 1: A generalised description of South African Karoo stratigraphy, palaeoenvironments and possible palaeontology.

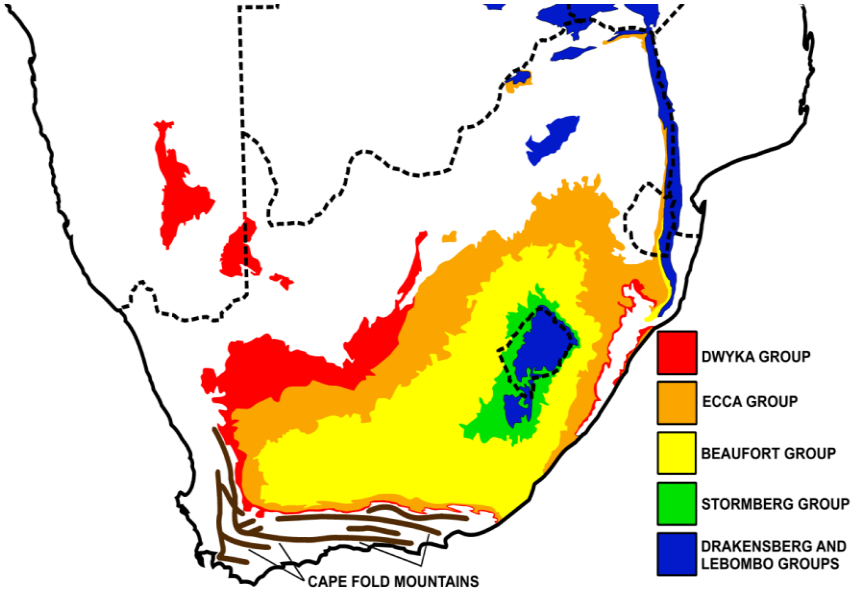

Figure 2: Distribution of Karoo rocks in southern Africa

Geology of the Study Area

The study area lies within the Springbok Flats Basin, not the main Karoo Basin. The 1:250 000 geological map shows the rocks to be those of the Ecca Group. In the Springbok Flats Basin, these rocks are known as the Hammanskraal Formation. The base of the sequence consist of sandstone, with shaly coal seams. These sediments are overlain by mudrock, coarse to fine sandstones and at the top of the succession bright coal seams are developed. The palaeoenvironment is interpreted as meandering rivers, in a cold, periglacial environment. The coal seams are thought to have formed in an oxbow lake environment.

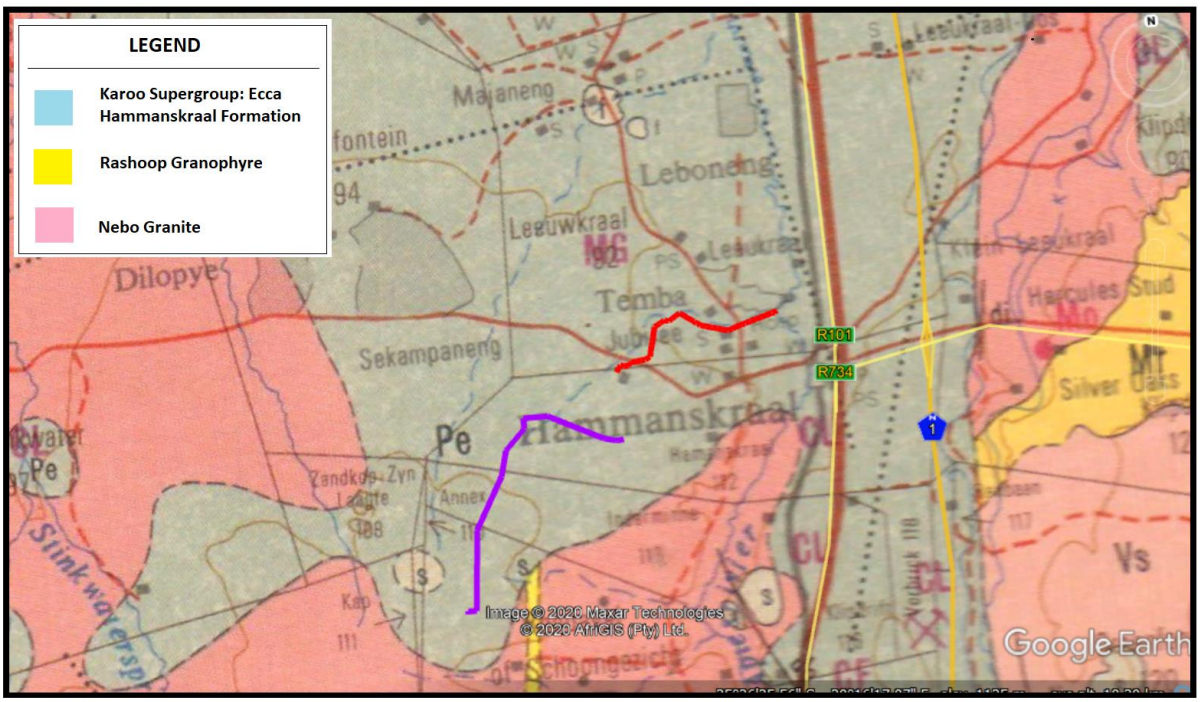

Figure 3: Geology of the Hammanskraal area.

Karoo Palaeontology

Rocks of the Karoo Supergroup in South Africa are of global palaeontological interest. At the end of Ecca times, about 252 million years ago, the End-Permian Mass Extinction wiped out more than 96% of life in the sea and more than 70% of its terrestrial life. The reasons for this are a matter of vigorous debate. The effects of this extinction event are recorded in Karoo rocks probably better than anywhere else on earth. During Beaufort times there was a great diversification of reptiles. By Elliot times, during the mid-Triassic, a variety of dinosaurs had emerged. Life perished locally with the extrusion of tholiitic basalt and eventual breakup of Gondwana.

Palaeontology of the study area

Fossils are well documented from the Ecca Group and include vascular plants (including petrified trees), and palynomorphs of *Glossopteris* flora. A rich palaeofauna includes mesosaurid reptiles, crustacea, non-marine bivalves, brachiopods, insects, and microfossils. Bioturbation is common in the mudstones, with *Planolites* and *Cruziana* trace fossils. A kaolinite and clay quarry of Cullinan Refractories is situated about 5 km to the south-east of Hammanskraal, and contain the plant *Glossopteris*. Fossil insects *Thaumalophora*, an aquatic nymph and *Sysciophlebia*, a tegmen of a spiloblattinid cockroach have been reported from carbonaceous shales in the locality.

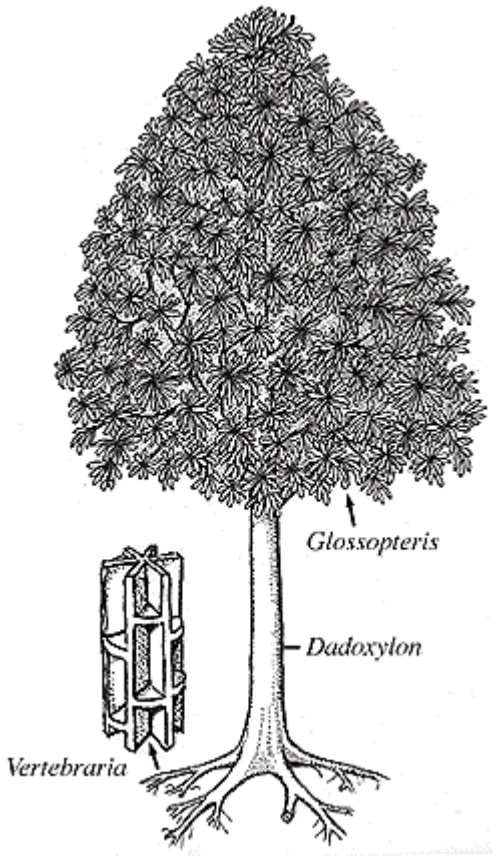

Figure 3: Reconstruction of the coal measure plant Glossopteris. Because it is highly unlikely to find the trunk, leaves and roots together, each part has a separate generic name although they are considered to be part of the same plant.

Observations

Recommendations and Conclusion

- There is no evidence of surface exposures of the Hammanskraal Formation in the study area, either from literature references or remote imagery, save in the Cullinan quarry as stated above. Therefore it is considered very unlikely that the construction of a subsurface pipeline will expose and disturb the rocks.
- During the construction work, all excavations into fresh rock should be monitored for *Glossopteris* by the responsible environmental control officer (ECO). Should fossiliferous material be found, the ECO should safeguard these *in situ* and alert SAHRA, so that appropriate action may be taken by a qualified palaeontologist. Mitigation would involve the scientific recording and sampling of fossil material.

Provided that these recommendations are implemented, it is likely that any possible negative impacts of the pipeline construction will be substantially reduced. Given observance of these protocols, it is therefore recommended that this proposed construction work proceeds.

Chris Jones
28th October 2020

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