DESKTOP PALEONTOLOGICAL ASSESSMENT FOR THE DALINKOSI BRIDGE OVER THE WASBANK RIVER, SOUTHEAST OF DALINKOSI, KWA-ZULU NATAL

FOR

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Declaration of Independence

This report has been compiled by Dr Alan Smith (Pr. Sc. Nat.) of Alan Smith Consulting, Durban. The views expressed in this report are entirely those of the author, if not then the source has been duly acknowledged. No other interest was displayed during the decision making process for the Project.

Specialist: Dr Alan Smith

Signature: 

EXECUTIVE SUMMARY

Alan Smith Consulting was appointed by Sinobuhle Mntambo, for SA SHEQ Consultants to conduct a Desk-Top field assessment of the potential impacts to Palaeontology Resources that might occur through the construction of the Dalinkosi Bridge, over the Wasbank River southeast of Dalinkosi, KwaZulu-Natal

Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), requires a Palaeontological Impact Assessment (PIA) to assess any potential impacts to palaeontological heritage.

This site contains Vryheid Formation and possibly Karoo Dolerite. The former is coded red by Sahris but in practice, except for coal seams (no economic seams in this area), contains no significantly fossils. Karoo Dolerite is unfossiliferous.

The chances of encountering significant fossils are **Low,** but N**ot Zero**; consequently a ***"Chance Find Protocol"*** has been included.

ACRONYMS

BA:	Basic Assessment
EDTEA:	(Department of) Economic Development, Tourism and Environmental Affairs
HIA:	Heritage Impact Assessment
PIA;	Palaeontological Impact Assessment
SAHRA:	South African Heritage Resource Agency
SAHRIS:	South African Heritage Resources Information System

1. TERMS OF REFERENCE

Alan Smith Consulting was requested by Sinobuhle Mntambo for SA SHEQ Consultants to provide a Desk-Top Palaeo Impact Assessment for the proposed Dalinkosi Bridge over the Wasbank River (Figures 1, 2). This report is to meet the requirements of the National Environmental Management Act (Act 107 of 1998) [as amended] Environmental Impact Assessment (EIA) regulations, Appendix 6.

Figure 1: Location of the proposed Dalinkosi Bridge (yellow peg).

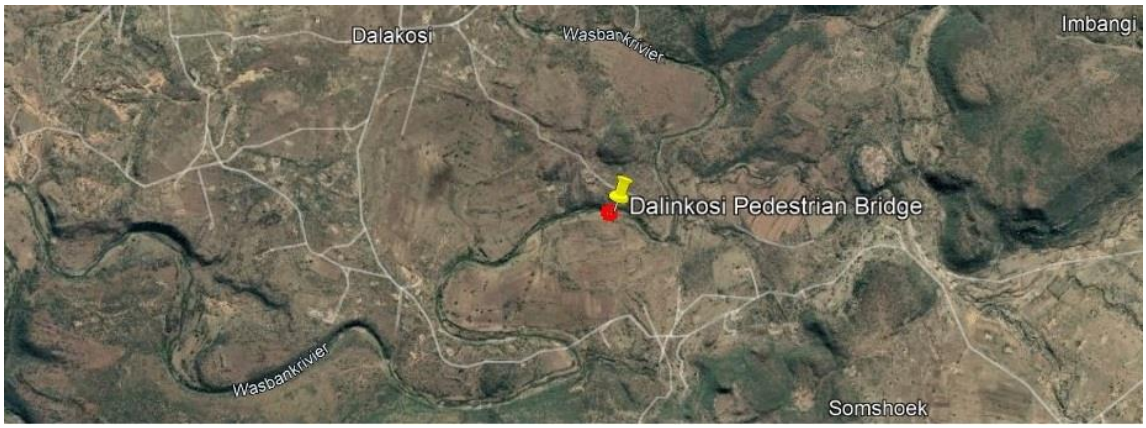

Figure 2: Zoomed location of proposed Dalinkosi Bridge (yellow peg).

2. SCOPE AND PURPOSE OF REPORT

A Palaeontological Impact Assessment (PIA) is a means of identifying any significant palaeontological material before development begins, so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This Desk-Top investigation fulfills the requirements of the heritage authorities (SAHRA), such that a comment can be issued by them for consideration by the competent authority (EDTEA), who will review the Basic Assessment (BA) and grant or refuse authorisation. The PIA report will outline any management and/or mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the conditions of authorisation, should this be granted.

3. METHODOLOGY

Geological maps, a literature review, personal experience and PhD research into the Vryheid Formation (see Section 9) were used in this research.

4. GEOLOGY

Rocks of the Vryheid Formation and Karoo Dolerite occur on this site (Figure 3).

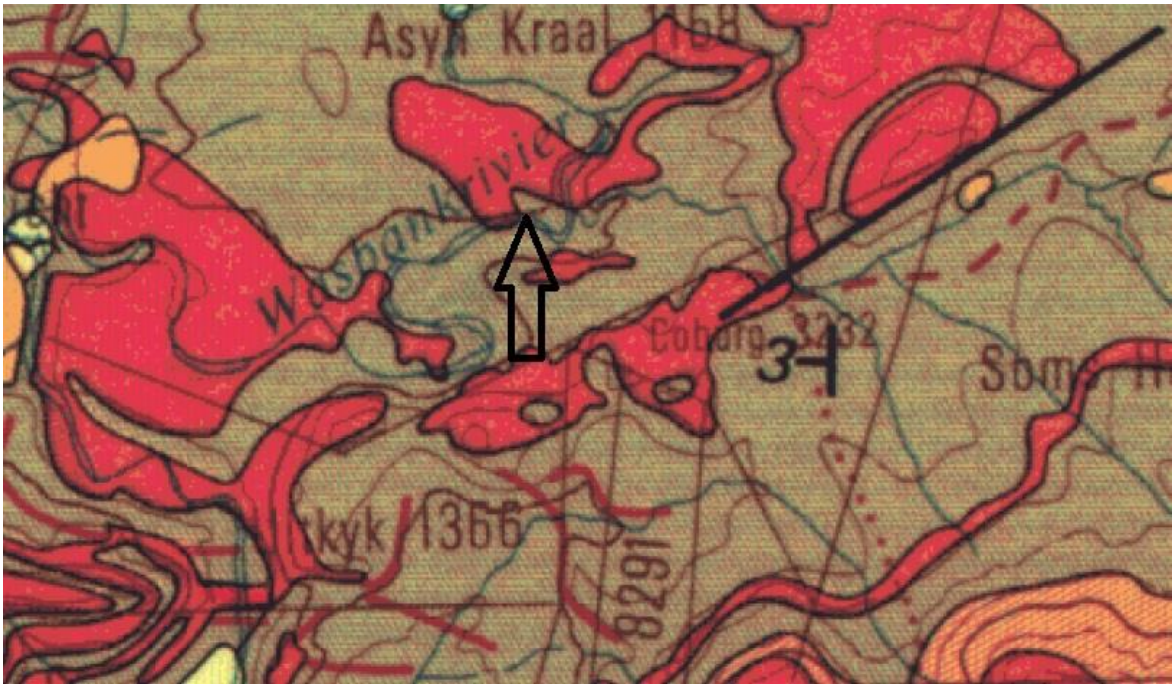

Figure 3: Approximate area of the Dalinkosi Bridge (arrowed). Extract from the 125 000 Geological Map: Dundee 2830. According to this map, the bridge crosses Vryheid Formation (Pv: grey).

Vryheid Formation

The Permian aged Vryheid Formation (Kungurian Stage ¬ 260 million years old: Green and Smith, 2012) comprises predominantly coarse-grained sandstone and siltstones, interbedded with dark shales and coal beds. The Formation is interpreted as "near-shore sandbars" and deltaic deposits that prograded into the ancient Karoo Sea. The latter was located within the central part of the Gondwana Supercontinent (Johnson et al, 2009). Coal can be present, but no significant seams are present in this area.

Karoo Dolerite

Karoo Dolerite, represented by dykes or sills, may be present within this area. This dolerite is part of the Karoo Large Igneous Province (LIP). The Karoo LIP is a sequence of lavas originally up to 4.5 km thick but which have been eroded to about 1.5 km. This basalt lava was extruded about 184 million years ago as a "Continental Flood Basalt", a

process that has never been witnessed by mankind. This event took place by fissure eruption. This event triggered the break-up of the Gondwana Supercontinent (Hastie et al., 2014).

5. PALAEONTOLOGY

The Vryheid Formation is red flagged on the Sahris Palaeosensitivity map (Figure 4). The colour coding used in the Sahris Palaeosensitivity Map is shown in Table 1.

Table 1: Summary of SAHRIS categories

Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required

Vryheid Formation

The Sahris Palaeosensitivity Map considers the Vryheid Formation as a **Very High Palaeosensitivity Zone** (Table 1; Figure 7). Plant fossils such as *glossopteris*, *gangamopteris*, and various tree species are recorded, especially from the coal seams. These fossils are important palaeo environmental indicators but are relatively common and not considered significant.

In practise, no significant terrestrial or marine fossils have been recorded from the Vryheid Formation. In contrast invertebrate trace fossils are common (Tavener Smith, 1983; Mason and Christie, 1985; Hastie et al., 2019), but these are not significant. Groenewald (2018) pointed out that the aquatic reptile, *Mesosaurus* (earliest known reptile from the Karoo Basin), as well as the fish, *Palaeoniscus capensis*, have been recorded in the Whitehill Formation in the Southern Cape, the southern part of the Karoo Basin (MacRae, 1999). The Whitehill Formation (500 km to the southwest), located

within the Main Karoo Basin, *may* be a correlative of the Vryheid Formation, however these rock units are not physically connected. Further, research has shown that the lower parts of the Vryheid Formation, in the eastern sector of southern Africa, has a different source area to the rest of the Vryheid Formation (Hastie et al., 2019). They suggested the Maurice Ewing Bank which was located between southern Africa and Antarctica prior to the breakup of the Gondwana Supercontinent, which hosted the Karoo Sea. This may be relevant in this case.

In this region thin (uneconomic) coal seams may be present in the Vryheid Formation (Tavener Smith, 1982; Hastie et al., 2019). Coal comprises compressed plant material and thus constitutes fossil material. Plants such as *glossopteris*, *gangamopteris* and *sigillaria* can be recognized, but these are common.

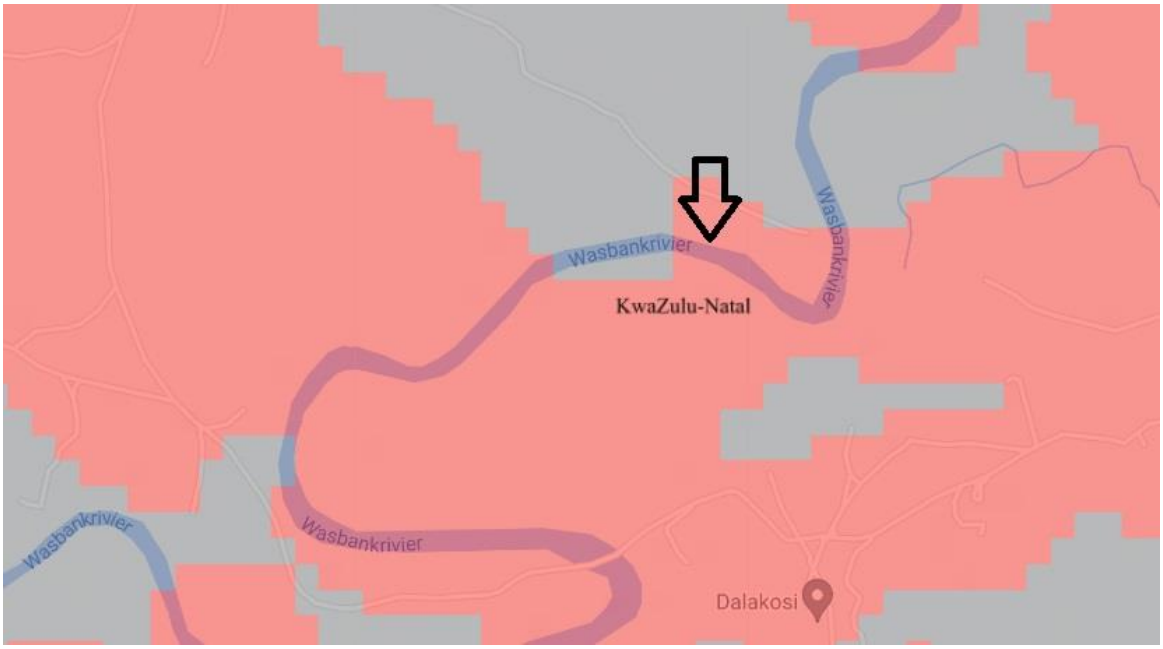

Figure 4: Palaeosensitivity of the Dalinkosi Bridge (arrowed) site. Extract from Sahris Palaeosensitivity Map).Vryheid Formation is red and Karoo Dolerite is grey.

Karoo Dolerite

Karoo Dolerite, grey in Figure 4, is an intrusive igneous rock and by definition not fossiliferous.

6. SUMMARY

The chance of fossils being found on this site is **Low,** but not **Zero.** A **"Chance Find Protocol" (Section 8)** has been included to cover this eventuality. No further palaeontological work is required, unless triggered by the "**Chance Find Protocol"** in which case a suitably qualified palaeontologist must be consulted. The "Chance Find Protocol" must form part of the Environmental Management Programme (EMPr) for the site,

7. REFERENCES

Green, A.N., Smith, A.M. (2012). Can ancient shelf sand ridges be mistaken for Gilbert-type deltas? Examples from the Vryheid Formation, Ecca group, KwaZulu-Natal, South Africa. J. Afr. Earth Sci. 76, 27–33.

Hastie, WW; Watkeys, MK; Aubourg, C (2014). Magma flow in dyke swarms of the Karoo LIP: Implications for the mantle plume hypothesis. Gondwana Research 25 (2014) 736–755.

Hastie, W; Watkeys, MK; Smith, AM, (2019). Tectonic significance of the sedimentary and palaeocurrent record at the eastern edge of the Karoo Basin. Journal of African Earth Sciences 158 (2019) 103543.

Johnson MR, Anhaeusser CR and Thomas RJ (Eds). (2009). The Geology of South Africa. GSSA, Council for Geoscience, Pretoria.

MacRae C. (1999). Life Etched in Stone. Geological Society of South Africa, Linden, South Africa.

Mason, TR and Christie AC, (1986). Palaeoevironmental significance of Ichnogenus Diplocraterion torell from the Permian Vryheid Formation of the Karoo Supergroup, South Africa. Palaeogeography, Palaeoclimatology, Palaeoecology, 52.

Sahris Palaeosensitivity Map: https://sahris.sahra.org.za/map/palaeo

Tavener Smith, (1982). Prograding coastal facies associations in the Vryheid formation (Permian) at Effingham quarries near Durban, South Africa. Sedimentary Geology Volume 32, Issues 1–2, May 1982, Pages 111-14

8. CHANCE FIND PROTOCOL

This Chance Find Protocol must be included in the site EMPr.

If any fossils are found, a Palaeontologist must be notified immediately by the ECO and/or EAP and a site visit must be arranged at the earliest possible time with the Palaeontologist.

In the case of the ECO or the Site Manager becoming aware of suspicious looking palaeo-material:

- The construction must be halted in that specific area and the Palaeontologist must be given enough time to reach the site and remove the material before excavation continues.

- Mitigation will involve the attempt to capture all rare fossils and systematic collection of all fossils discovered. This will take place in conjunction with descriptive, diagrammatic and photographic recording of exposures, also involving sediment samples and samples of both representative and unusual sedimentary or biogenic features. The fossils and contextual samples will be processed (sorted, sub-sampled, labeled, and boxed) and documentation consolidated, to create an archive collection from the excavated sites for future researchers.

Functional responsibilities of the Developer

1. At full cost to the project, and guided by the appointed Palaeontological Specialist, ensure that a representative archive of palaeontological samples and other records is assembled to characterize the palaeontological occurrences affected by the excavation operation.

2. Provide field aid, if necessary, in the supply of materials, labour and machinery to excavate, load and transport sampled material from the excavation areas to the sorting areas, removal of overburden if necessary, and the return of discarded material to the disposal areas.

3. Facilitate systematic recording of the stratigraphic and palaeo-environmental features in exposures in the fossil-bearing excavations, by described and measured geological sections, and by providing aid in the surveying of positions where significant fossils are found.

4. Provide safe storage for fossil material found routinely during excavation operations by construction personnel. In this context, isolated fossil finds in disturbed material qualify as “normal” fossil finds.

5. Provide covered, dry storage for samples and facilities for a work area for sorting, labeling and boxing/bagging samples.

6. Costs of basic curation and storage until collected. Documentary record of palaeontological occurrences must be done.

7. The contractor will, in collaboration with the Palaeontologist, make the excavation plan available to the appointed specialist, in which appropriate information regarding plans for excavations and work schedules must be indicated on the plan of the excavation sites. This must be done in conjunction with the appointed specialist.

8. Initially, all known specific palaeontological information will be indicated on the plan. This will be updated throughout the excavation period.

9. Locations of samples and measured sections are to be pegged, and routinely and accurately surveyed. Sample locations, measured sections, etc., must be recorded three-dimensionally if any “significant fossils” are recorded during the time of excavation.

9. DETAILS OF SPECIALIST

Dr Alan Smith
Private Consultant: ***Alan Smith Consulting, 29 Brown's Grove, Sherwood, Durban, 4091***

&

Honorary Research Fellow: ***Discipline of Geology, School of Agriculture, Earth and Environmental Sciences, University of KwaZulu-Natal, Pietermaritzburg***.

Role: Specialist Palaeontological Report production

Expertise of the specialist: Dr Alan Smith: CV (short)

Dr Alan Smith Pr. Sc. Nat., I.A.H.S.

Selected References:

- MSc in palaeontology. The Stromatolites of Etosha Pan. (University of KwaZulu-Natal).
- Alan has published 9 refereed journal articles on "Stomatolites" with one under review.
- Alan is part of the Epstrom international collaboration on extant stromatolites. This is sponsored by the United Kingdom's Natural Environment Research Council (NERC). This project includes Essex (UK), Nelson Mandela, Ulster (UK), Rhodes, Witwatersrand and KwaZulu-Natal Universities and the Geosciences Council of SA.
- PhD in Geology (University of KwaZulu-Natal), Expert in the Vryheid Formation (Ecca Group) in northern KZN, this having been the subject of PhD.
- Other scientific research experience includes: Fluvial geomorphology, palaeoflood hydrology, Cretaceous deposits.
- Alan's experience includes understanding Earth Surface Processes and hazards they pose in both fluvial (river floods) and coastal environments.
- Alan has published in both national and international, peer-reviewed journals. He has published more than 50 journal articles with +620 citations (detailed CV available on request).
- Alan has attended and presented scientific papers and posters at numerous international and local conferences (UK, Canada, South Africa) and is actively involved in science research.
- Alan has been writing Palaeontological Reports since 2014.