TERMS OF REFERENCE FOR SPECIALIST STUDIES

FOR INCLUSION IN

BASIC ASSESSMENT REPORT 24/2011

PROPOSED PERIODIC MAINTENANCE OF SECTION 11 OF THE N10

GROBLERSHOOP-LAMBRECHTSDRIFT

NORTHERN CAPE

OCTOBER 2011

Contents

1. Background Information

SANRAL SOC intends to undertake periodic maintenance on Section 11 of the N10, between Groblershoop (Km 0,0) and Lambrechtsdrift (Km 61,1), and has therefore requested a quotation for environmental practitioner services. This quotation has to include the cost of a survey by a palaeontologist.

The proposed maintenance works will comprise the following:

- Widening of four bridges, from a current width of approximately 7 m to 10,4 m, including new parapets
- Repairs/pretreatment of 8,6 km of existing road pavement, followed by a surface seal constructed on the existing levels
- Repairs/pretreatment of 52,5 km of existing pavement to the existing levels, including the widening and strengthening of the existing gravel shoulders to a minimum width of 7,4 m, followed by a surface seal constructed on existing levels
- Improvement of nine resting areas, including strengthening and/or additional pavement layers and surfacing constructed to new levels
- Geometric/safety improvements at four intersections
- Upgrading of four intersections and nine resting areas
- Treatment of existing road surfacing with various forms of localised repairs
- Resealing of the existing road over a distance of 61,1 km

2. Specialist Studies

2.1 Desired Approach for a Specialist Study

- Outline the study approach
- Identify and describe assumptions
- Identify sources of information
- Perform gap analysis
- Describe affected environment
- Describe nature of effects
- Perform sensitivity analysis
- Identify current and future risks
- Quantify and describe impacts
- Assess and evaluate impacts
- Identify and assess alternatives
- Propose and evaluate mitigation
- Summarise impacts after mitigation
- Propose monitoring programme

2.2 General Requirements for Specialist Reports

The specialist report must supply a non-technical summary of the study, as many interested and/or affected parties are not skilled. Compilation of the report should be guided by the Environmental Impact Assessment Regulations (GG 33306, GN R. 543, dated 18 June 2010, in terms of the National Environmental Management Act (Act No 107 of 1998)). Reports should include the following:

- Executive summary
- Definition of scope, including the purpose for which the report was prepared
- Description of research methodology, including:
    - Review of available information
    - Establishment of baseline conditions
    - Field surveys and data collection
- Methodology adopted in preparing the report, including:
    - Description of assumptions
    - Uncertainties or knowledge gaps
- Criteria used

- Identification and prediction of impacts, including:
    - Description of findings
    - Potential implications of the environmental impact of the proposed activity
    - Identification of alternatives
- Results, recommendations, mitigation and monitoring requirements
- Maps, figures, tables and graphs
- Description of consultation processes undertaken during the course of the study
- Summary and copies of comments received during consultation processes
- Any other information requested by the competent authority or the EAP
- Complete reference list
- Details of the specialist who prepared the report
- Curriculum Vitae, indicating expertise of the specialist to conduct the specialist study
- Declaration of the independence of the person compiling the report

2.3 Deliverables

Reports must be submitted to the Environmental Assessment Practitioner in both pdf and MS Word format, and must be complete, with figures and appendices in the correct order. A submission deadline will be negotiated between the EAP and the specialist on appointment.

An invoice, made out to Van Zyl Environmental Consultants must be submitted with the report. Please note that Van Zyl Environmental Consultants is not registered for VAT.

Reports should be submitted on time to ensure that the critical route of the Environmental Project Process Schedule stay on track and on time. In the event of late submission of a report, penalties of R 500 per day will be subtracted from the invoice delivered.

RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES & MITIGATION:

PROPOSED UPGRADING OF FOUR ROAD BRIDGES ALONG THE N10 BETWEEN GROBLERSHOOP & LAMBRECHTSDRIFT, NORTHERN CAPE

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1. OUTLINE OF DEVELOPMENT

SANRAL SOC intends to undertake periodic maintenance on Section 11 of the N10 trunk road, between Groblershoop (Km 0,0) and Lambrechtsdrift (Km 61,1, towards Upington), Northern Cape. The present study concerns the widening of four bridges from a current cross section of approximately 7 m to 10.4 m, including new parapets.

The four bridges concerned, listed from south to north (Fig. 1), are:

Bridge 1: Saalskop River Bridge (route km 23; 28˚ 45' 53.4" S, 21˚ 50' 51.7" E);
Bridge 2: Kalkwerf Sloot Bridge (route km 39.3; 28˚ 39' 9.30" S, 21˚ 45' 44.00" E);
Bridge 3: Ezelfontein River Bridge (route km 44.3; 28˚ 36' 36.5" S, 21˚ 45' 25.9" E);
Bridge 4: Boom River Bridge (route km 60.6; 28˚ 29' 40.9" S, 21˚ 41' 29.2" E).

The construction process involves the following main components:

- Excavation of holes in the river bed for new footings
- Construction of pillars
- Walls underneath the bridge and on the sides
- Deck on top
- Sides of bridge
- Road safety features

The present palaeontological heritage comment has been commissioned by Van Zyl Environmental Consultants cc as part of a comprehensive Heritage Impact Assessment of the proposed development (Contact details: Irmé van Zyl. PO Box 567,Upington 8800. Telephone: 054 338 0722. Mobile: 072 222 6194. Email: ibvanzyl@telkomsa.net). A brief field assessment of each site was conducted by the author over the period 2-3 March 2012.

2. GEOLOGICAL BACKGROUND

The geology of the N10 study area between Upington and Groblershoop is shown on the 1: 250 000 geology map 2820 Upington (Council for Geoscience, Pretoria; Fig. 1 herein). A comprehensive sheet explanation for this map has been published by Moen (2007). All four bridge sites are underlain by ancient Precambrian igneous and metamorphic rocks that belong to the **Namaqua-Natal Province** of Mid Proterozoic (Mokolian) age (Cornell *et al.* 2006, Moen 2007).

These basement rocks are approximately two to one billion years old and are entirely unfossiliferous (Almond & Pether 2008) (Figs. 3, 4).

The Precambrian basement rocks within the study area are mantled with a spectrum of other coarse to fine-grained **superficial deposits** such as rocky soils, downwasted surface gravels, colluvium (slope deposits), sheet wash, calcrete hardpans, aeolian sands and alluvium of intermittently flowing streams. These younger deposits are generally young (Quaternary to Recent) and are largely unfossiliferous. Some of the older calcretes may be equated with the Mokalanen Formation of the Kalahari Group.

According to Moen (2007) **older river terrace gravels** of possible Late Tertiary to Pleistocene age occur "all along the river" within 2 km of the present banks and at elevations of up to 45 m (rarely as high as 85m) above the present flood plain. Small patches of older terrace gravels are mapped along the eastern banks of the River Orange in the broader study region (Fig. 1, red arrows), but not along the western bank where the N10 road runs. These older river gravels are frequently calcretised.

The study region along the west bank of the Orange River comprises arid, hilly terrain with vegetation mainly confined to watercourses. Levels of bedrock exposure are often poor, since the surface is usually mantled by rocky colluvium and alluvium of numerous ephemeral streams feeding into the Orange River. Informative road cuttings are few, and there are also only limited bedrock exposures in the shallow river valleys (Figs. 3 & 4).

The alluvial sediments in the immediate neighbourhood of the bridge footings at all four sites under consideration were extensively disturbed by heavy machinery. Coarse, poorly-sorted, subrounded to angular alluvial gravels in the river bed consist of various porphyritic and amygdaloidal lavas, quartzites (often purplish), mica schist and other basement igneous and metasedimentary rocks as well as vein quartz and reworked pebbly calcrete. Occasional flaked cores and large flakes in reddish-brown and purplish quartzite were noted in these deposits. Some river beds are primarily floored by sandy and silty alluvium. Good vertical sections through bedded finer alluvium were not observed. The apparently well-bedded deposits at the foot of Bridge 3 are in fact artificial, as shown by concrete block inclusions (Fig. 5).

In the river banks the coarse gravels are overlain by buff to orange-brown silty alluvium and soils up to few meters thick (Fig. 6). This stratigraphic relationship may be attributed to limited lateral channel migration rather than deep stream incision. However, older coarse, angular to subrounded terrace gravels are visible several (2-3) m above the present river bed some 100-150 m upstream of Bridge 4 (Fig. 6). In the same area can be seen a well-developed calcrete hardpan containing sparse gravel clasts (calcretised soil with downwasted surface gravels; Figs. 7 & 8) as well as heavily calcretised older alluvial gravels with much more concentrated gravel clasts (Fig. 9). In the former case, occasional flaked quartzite clasts suggest a Pleistocene maximum age.

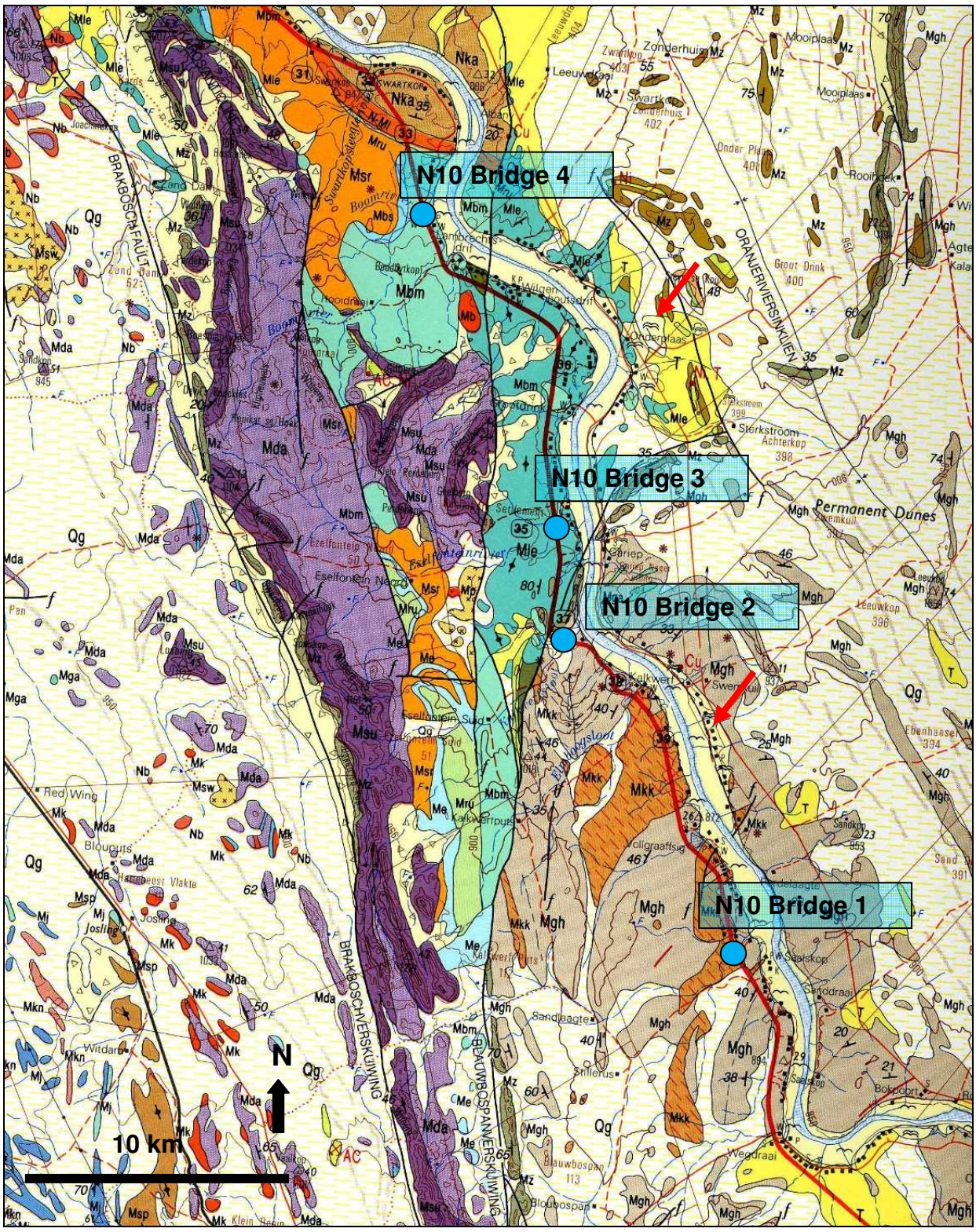

Fig. 1. Extract from 1: 250 000 geological map 2820 Upington (Council for Geoscience, Pretoria) showing the location of the four bridge sites along the N10. The study area is almost entirely underlain by unfossiliferous Precambrian (Middle Proterozoic / Mokolian) basement rocks of the Namaqua-Natal Metamorphic Province (Mkk, Mgh, Mle, Mbm *etc*). Superficial sediments of Late Caenozoic age include calcretes (T, bright yellow), reddish aeolian sands of the Gordonia Formation, Kalahari Group (Qg), and alluvium of the Orange River (pale yellow). Small patches of older terrace gravels (red arrows) are mapped on the eastern bank of the river, but not close to the N10 along the west bank.

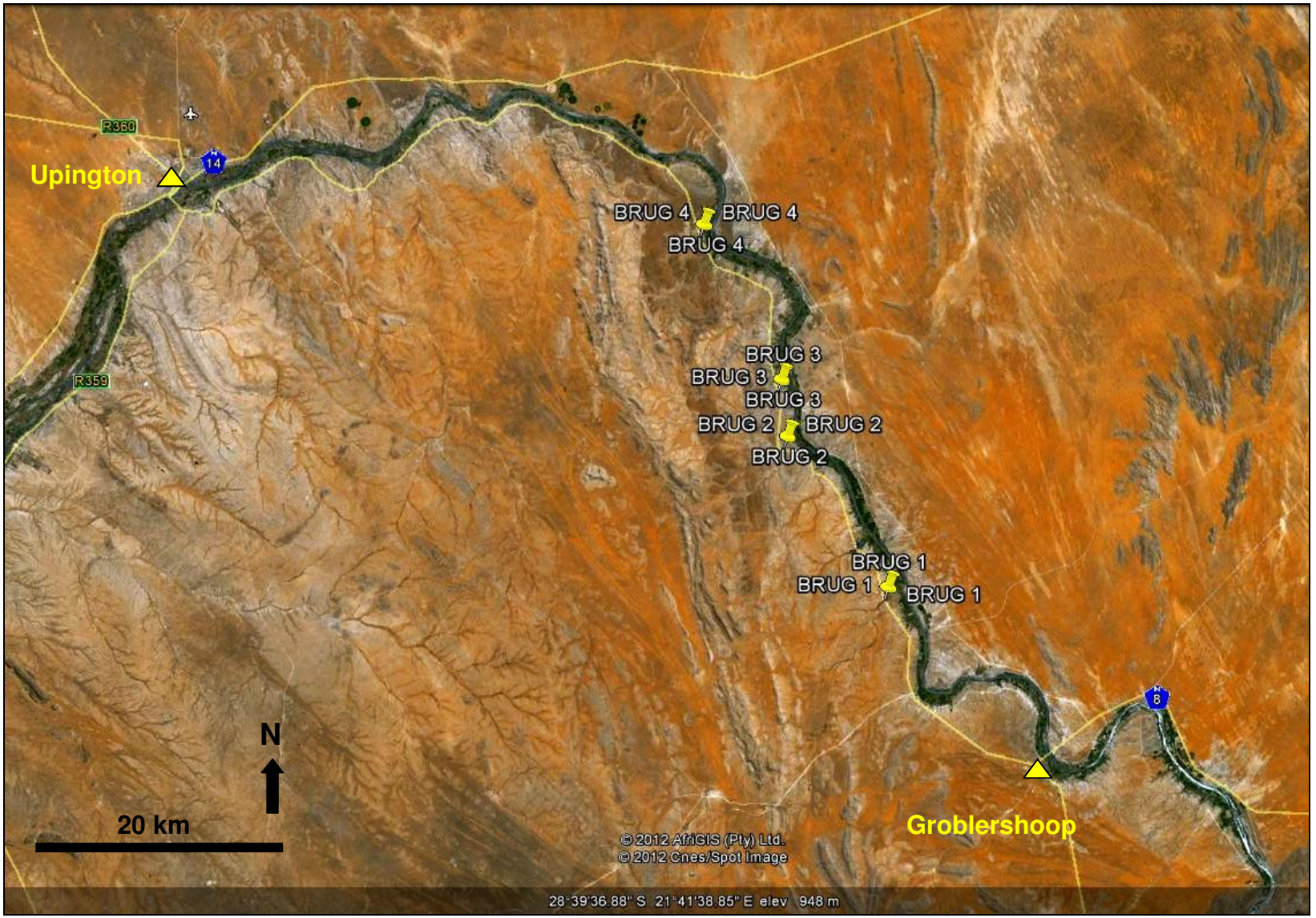

Fig. 2. Google earth© satellite image of the Orange River between Upington and Groblershoop, Northern Cape, showing the four bridge sites along the N10.

Fig. 3. Riverbank exposure of well-bedded Precambrian quartzites of the Groblershoop Formation (Brulpan Group) on the NE side of Bridge 3 (Hammer = 32 cm).

Fig. 4. Bedrock exposure adjacent to footings of Bridge 3 showing highly foliated schists of the Leerkrans Formation (Wilgenhoutsdrif Group) that are cross-cut by quartz veins (Hammer = 32 cm).

Fig. 5. Poorly-sorted, well-bedded alluvial sediments adjacent to footings of Bridge 3 (Hammer = 32 cm). Inclusions of concrete (arrow) show that this is in fact an artificial deposit.

Fig. 6. View eastwards towards Bridge 4 from *c.* 100m upstream. Note terrace of older coarse alluvial gravels in foreground, several meters above the level of the modern river channel.

Fig. 7. Calcrete hardpan in riverbank c. 150 m upstream of Bridge 4 showing well-spaced gravel inclusions (Hammer = 32 cm). Very sparse flaked quartzite clasts were observed here, suggesting a Pleistocene or younger age, but no fossil remains were seen.

Fig. 8. View south-westwards along the river channel, *c.* 240 m upstream of Bridge 4, showing calcretised older alluvial gravels in the foreground (Hammer = 32 cm).

Fig. 9. Heavily-calcretised older alluvial gravels *c.* 200m upstream of Bridge 4 (Hammer = 32 cm). Very sparse flaked quartzite clasts were observed within these gravels, suggesting a Pleistocene or younger age, but no fossil remains were seen.

3. PALAEONTOLOGICAL HERITAGE

The Precambrian metamorphic and igneous basement rocks of the Namaqua-Natal Metamorphic Province in the study area are entirely unfossiliferous.

Late Caenozoic calcretes may contain trace fossils such as rhizoliths, termite and other insect burrows, or even mammalian trackways. Mammalian bones, teeth and horn cores (also tortoise remains, and fish, amphibian or even crocodiles in wetter depositional settings) may be occasionally expected within Kalahari Group sediments and calcretes, notably those associated with ancient alluvial gravels and pans (*cf* Almond 2008). However, these fossil assemblages are generally sparse, low in diversity, and occur over a wide geographic area, so the palaeontological sensitivity of the calcretes within the study region is rated as low. This applies equally to the thin veneer of other surface deposits (rocky scree, stream alluvium *etc*) within this highly arid region.

Alluvial gravels of the Orange River of Miocene and younger age are locally highly fossiliferous (*e.g.* Hendy 1984, Schneider & Marias 2004, Almond 2008, 2009 and extensive references therein) but, as argued above, these are *not* mapped within the study area. Younger silty alluvial deposits may contain a range of terrestrial and freshwater fossils and subfossils. Freshwater snails are mentioned in particular by Moen (2007, p. 150).

No fossils were observed within the alluvial sediments, including older consolidated gravels, at the four N10 bridge sites. Sediments in the area immediately surrounding each bridge are heavily disturbed. The palaeontological sensitivity of all four of the N10 bridge study areas is assessed as LOW.

4. CONCLUSIONS & RECOMMENDATIONS

The overall impact significance of the proposed N10 road bridge developments is considered to be LOW because:

- The study areas are underlain by unfossiliferous metamorphic and igneous basement rocks (quartzites, schists, lavas *etc*) or mantled by superficial sediments of low palaeontological sensitivity;
- Extensive, deep excavations are not anticipated;
- The four bridge sites are highly disturbed.

It is therefore recommended that exemption from further specialist palaeontological studies and mitigation be granted for these road bridge developments.

Should any substantial fossil remains (*e.g.* vertebrate bones and teeth, shells, petrified wood) be encountered during excavation, however, these should be reported to SAHRA for possible mitigation by a professional palaeontologist.

5. REFERENCES

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6. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape under the aegis of his Cape Town-based company *Natura Viva* cc. He is a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape as well as Limpopo, Free State and Gauteng for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

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