

# PALAEONTOLOGICAL SPECIALIST STUDY: FIELD ASSESSMENT

## EXISTING BORROW PIT ALONG THE DR1380 NEAR ROBERTSON, LANGEBERG MUNICIPALITY, WESTERN CAPE

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### 1. EXECUTIVE SUMMARY

The DR01380/4.0/R/100 borrow pit, situated in the Worcester – Robertson Karoo about 16.5 km WNW of Robertson, Breedevallei District, is excavated into shallow marine sediments of the Mid to Late Devonian Swartruggens Formation of the lower Witteberg Group (and *not* the Early Carboniferous non-marine Waaipoort Formation as indicated on the geological map). This is one of the largest excavations into the Swartruggens succession available, but bedrock exposure here is very poor due to the mantle of recently excavated rock rubble. Apart from possible problematic “worm tubes” and transported vascular plant remains, body fossils are hitherto almost unknown within this rock unit. Only low diversity trace fossil assemblages, including poorly preserved helical burrows of the ichnogenus *Spirophyton*, are recorded within the present pit.

The palaeontological sensitivity of the site is correspondingly low and, pending the discovery of substantial new fossil material such as shelly fossil, fish or plant remains, no further mitigation of fossil heritage for this borrow pit is recommended.

### 2. INTRODUCTION

The Department of Transport, Western Cape, is applying to the Department of Mineral Resources for approval to exploit road material from a large existing borrow pit along the unsealed road DR1380 in the Worcester – Robertson Karoo (Breedevallei District). Pit DR01380/4.0/R/100 (31° 46' 37.3" S, 19° 42' 37.1" E) on Worcester Farm No. 467 (Eilandia Noord) is situated about 3 km southwest of the R60 tar road between Worcester and Robertson and some 16.5 km WNW of the town of Robertson (Figs. 1 & 2) .

A previous desktop basic assessment of the pit by the author assessed its palaeontological heritage sensitivity as high due to the presence here of known fossiliferous sediments of the Waaipoort Formation (Upper Witteberg Group / Lake Mentz Subgroup), as based on the relevant geological map (but see discussion in Section 3 below). A palaeontological field assessment of the pit as part of an HIA was requested by Heritage Western Cape (HWC Case Ref. 111124JL17, Interim Comment 7 December 2011) in accordance with the requirements of the National Heritage Resources Act, 1999 (Section 38). The present palaeontological heritage field assessment and short report were accordingly commissioned by Vidamemoria Heritage Consultants, Cape Town (Address: 3<sup>rd</sup> Floor, Guarantee House, 37 Burg Street, Greenmarket Square, Cape Town; tel: 021-424 8432; e-mail: Quahnita@vidamemoria.co.za). Fieldwork for this project was carried out on 13 May 2012.

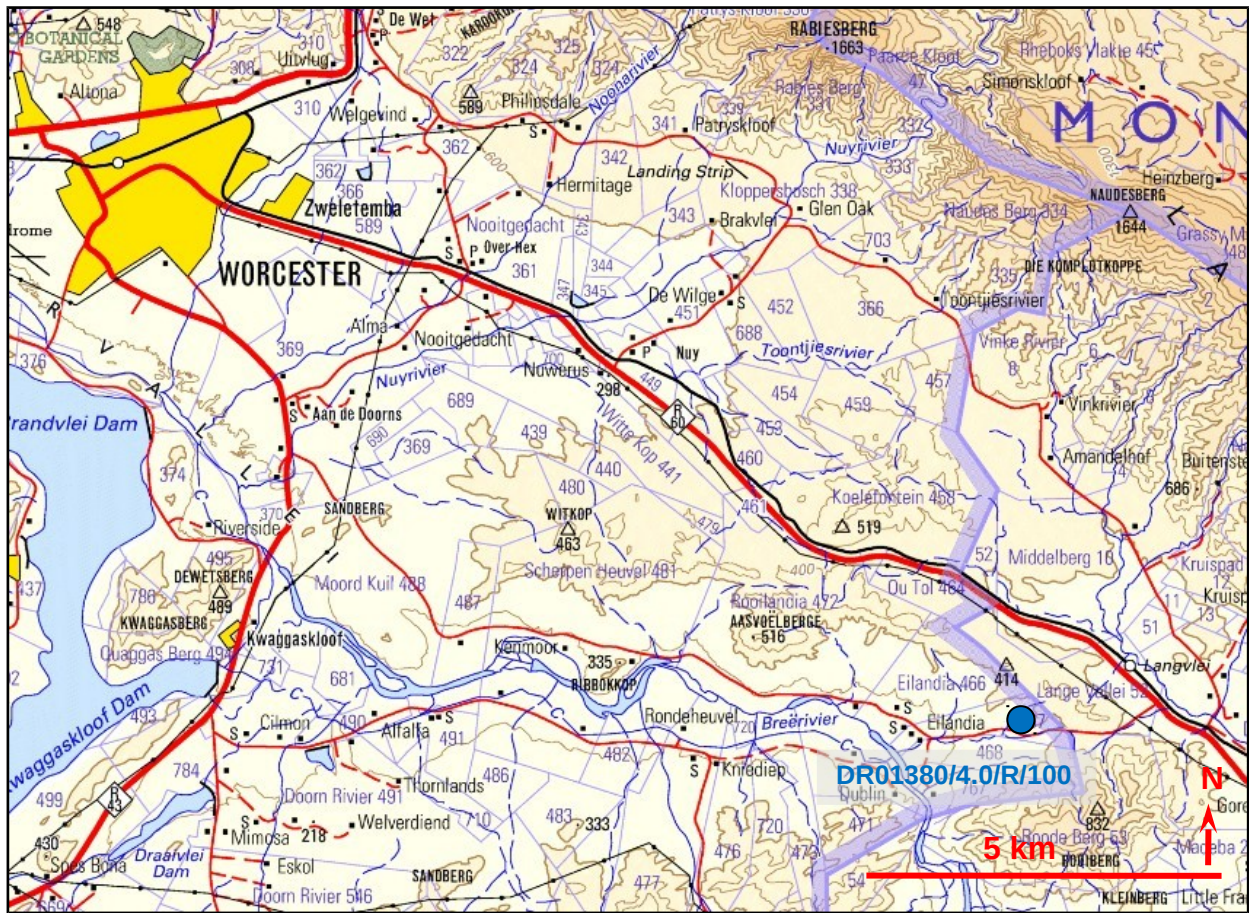
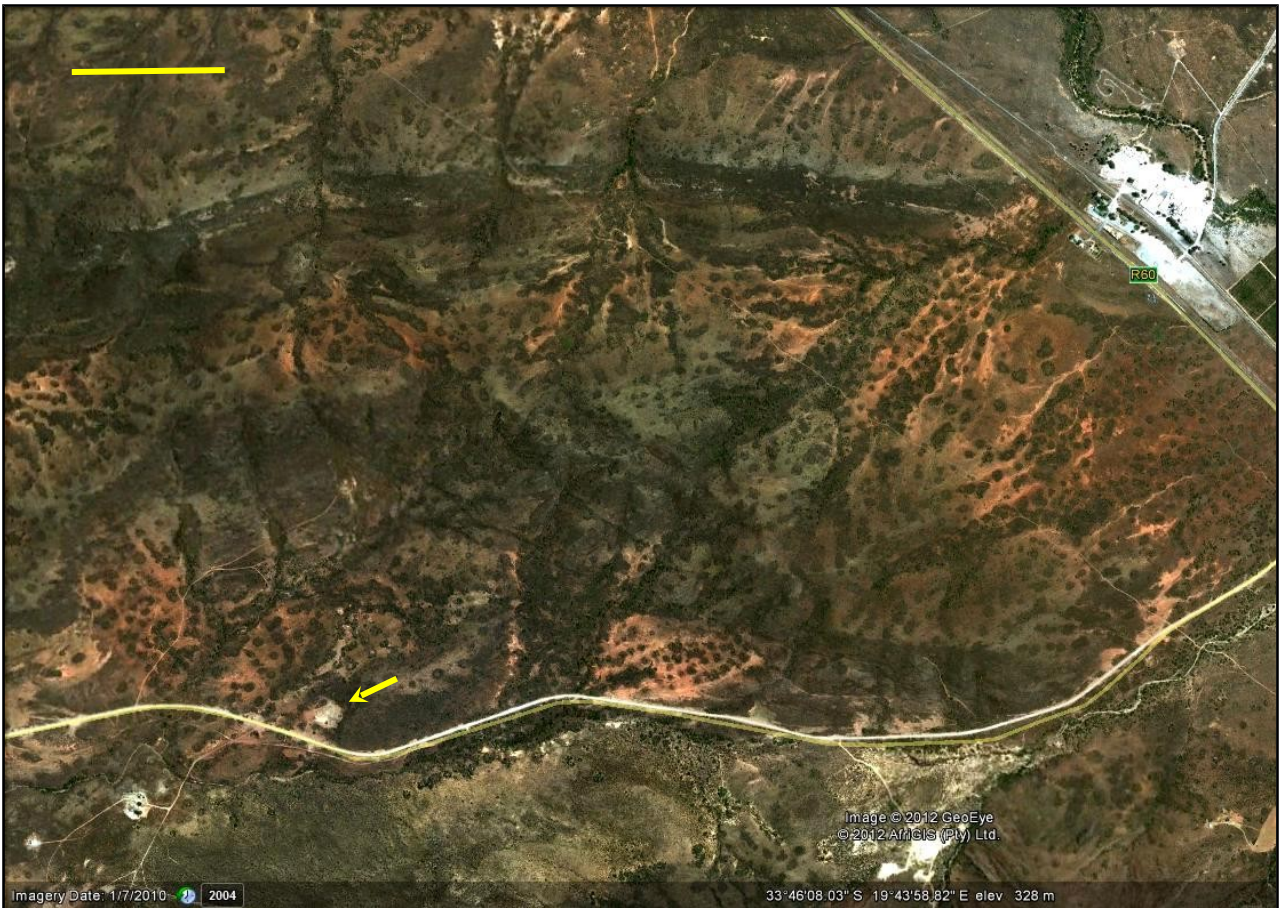


Fig.1. Extract from topographical sheets 3119 Worcester (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the approximate location of the existing pit DR01380/4.0/R/100 located c. 16.5 km WNW of Robertson in the Breedevallei District, Western Cape (blue dot).





**Fig. 2. 2004 Google earth© satellite image of the study area showing the existing DR01380/4.0/R/100 pit on the north side of the DR1380 (yellow arrow) on the farm Eilandia Noord. The pit has since been considerably enlarged. The yellow scale bar = c. 500 m.**

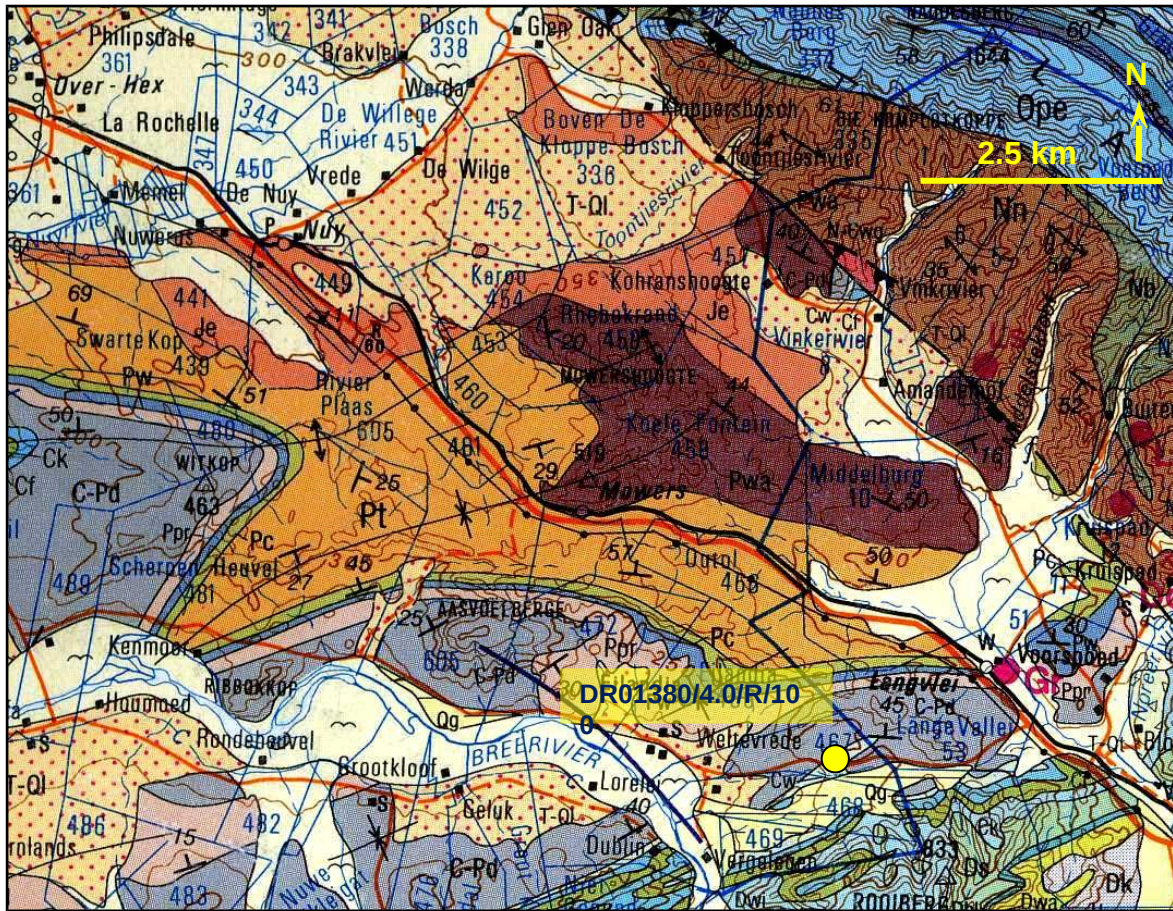
### **3. GEOLOGICAL HERITAGE**

The geology of the Robertson study area is shown on 1: 250 000 geology sheet 3319 Worcester (Council for Geoscience, Pretoria) and is shown here in Fig. 3. A short sheet explanation has been published by Gresse & Theron (1992; see also the older 1: 125 000 Worcester- Hermanus map and sheet explanation by De Villiers *et al.* 1964). The pit area is underlain by shallow marine sediments of the lower **Witteberg Group** (Weltevrede Subgroup, Cape Supergroup) that here form a small inlier almost completely surrounded by younger Dwyka Group rocks. The Witteberg Group succession in this part of the Worcester-Robertson Karoo forms part of a major NE-plunging syncline with a SW-NE trending axis. As mapped, the pit is excavated into rocks of the Early Carboniferous **Waaipoort Formation** (Dw, pale green in Fig. 3) that belongs to the upper Witteberg Group (Lake Mentz Subgroup) (Broquet 2002, Thamm & Johnson 2006). However, on the basis of the sedimentary facies (*e.g.* purplish micaceous mudrocks) and the trace fossil assemblages (*e.g.* *Spirophyton*) the rocks here are more properly assigned to the older, Middle to Late Devonian Weltevrede Subgroup. They most probably belong to the **Swartruggens Formation** (Ds, medium green in Fig. 3) that is also mapped along the mountain front just to the southeast. This probably reflects repetition of the Swartruggens succession due to small scale folding along SW-NE axes along the south-eastern limb of the major synclinal structure mentioned earlier.

The prominently-banded Swartruggens Formation, as well seen in the Rooiberg Range of countains to the south of Eilandia, is made of up numerous small-scale shoaling cycles (parasequences) of wavy-laminated, micaceous siltstone and hummocky cross-stratified or swaley sandstone or quartzite. The succession totals about 300m in Karooport (De Beer 1990, Gresse



& Theron 1992). These cycles reflect rapid changes in Late Devonian (Frasnian) sea level that may have been driven by fluctuations in the growth and decay of Gondwana ice caps (Cotter 2000). Detailed analysis of the sedimentology of this unit at Elim near Karooport with comments on the abundant associated trace fossils are given by Cotter (2000).



**Fig. 3. Extract from 1: 250 000 geology sheet 3119 Worcester (Council for Geoscience, Pretoria) showing location of the DR01380/4.0/R/100 borrow pit c. 16.5 km WNW of Robertson. The pit is excavated into micaceous sediments of the lower Witteberg Group (probably Swartruggens Formation, Ds) that are incorrectly assigned on the geological map to the Waaipoort Formation (Cw).**

This is one of the largest quarries excavated into the Swartruggens Formation. Unfortunately, as a result of recent extensive excavation and perhaps rehabilitation within the DR01380/4.0/R/100 borrow pit, the Swartruggens bedrocks are mantled with rock rubble and are now poorly exposed (Figs. 4 & 5). They comprise grey, greyish-green, pinkish and lilac, thin- to medium-bedded micaceous wackes and siltstones with subordinate darker maroon or reddish brown bands. Bedding is tabular to lenticular while small scale wave ripple structures, ripple cross lamination, flaser and lenticular bedding are common. Primary sedimentary structures are often destroyed by high levels of bioturbation, as also indicated by extensive mottling (Fig. 6).





**Fig. 4. Eastwards view across the large DR01380/4.0/R/100 borrow pit showing very limited bedrock exposure of the Swartruggens Formation here.**



**Fig. 5. Small exposure of Swartruggens micaceous siltstone bedrock beneath the mantle of rock rubble (Hammer = 27 cm).**



**Fig. 6. Float block of Swartruggens micaceous silty sandstones showing disruption of primary wavy lamination due to extensive bioturbation (Block is c. 30 cm thick).**

#### **4. PALAEOLOGICAL HERITAGE**

The palaeontology of the Swartruggens Formation is still poorly understood (De Beer 1990, Cotter 2000, Almond 2008, and unpublished observations). Apart from sparse, mainly unsubstantiated, reports of vascular plants, body fossils are not recorded from western outcrop of the Swartruggens Formation (Shelly fossils mentioned from here by Rust 1973 are actually from the older Wagen Drift Formation). Trace fossils of the *Skolithos*, *Cruziana* and (especially) the *Spirophyton* ichnofacies are common in the Cederberg range and elsewhere however. They comprise some twenty ichnogenera in total, though most assemblages are low diversity to monospecific. Trace fossils noted during recent field surveys include small vertical U-tubes (*Arenicolites*), vertical pipes (*Skolithos*), possible small bivalve burrows (*Lockeia*), abundant *Spirophyton*, including forms with and without a marginal tube, meniscate back-filled burrows of the *Scolicia* Group that may have been generated by bellerophonitid “gastropods” (possibly *Psammichnites* or *Olivellites*) and various simple horizontal to oblique burrows (Almond 2010). Two specimens of a problematic, finely-annulated tubular skeleton have also been found in this succession (*ibid.*).

The great majority of the ichnogenera mentioned are shared with similar tempestite (storm deposited) facies in the slightly older Wagen Drift Formation (Almond 2010). The impoverishment of the nearshore burrowing infauna in these high palaeolatitude seas might be related to cold, near-polar climates, intermittent bottom anoxia, and / or the series of biotic crises that characterize Late Devonian biotas worldwide - the so-called Frasnian – Famennian mass extinction events (*cf* Copper 1986, Joachimski & Buggisch 1993, McGhee 1989, 1996, 2001).

Low diversity ichnoassemblages are visible on float blocks in the Eilandia quarry (Figs. 7 to 9). Most of the traces, apart from *Spirophyton*, are not readily identifiable to ichnogenus. They include various vertical, oblique and horizontal burrows and may be very dense in some horizons. Within the Witteberg Group *Spirophyton* is restricted to the marine-influenced Weltevrede Subgroup (including the Swartruggens Formation) and the Witpoort Formation but does not occur in the overlying Lake Mentz Subgroup (*e.g.* Waaiport Formation).



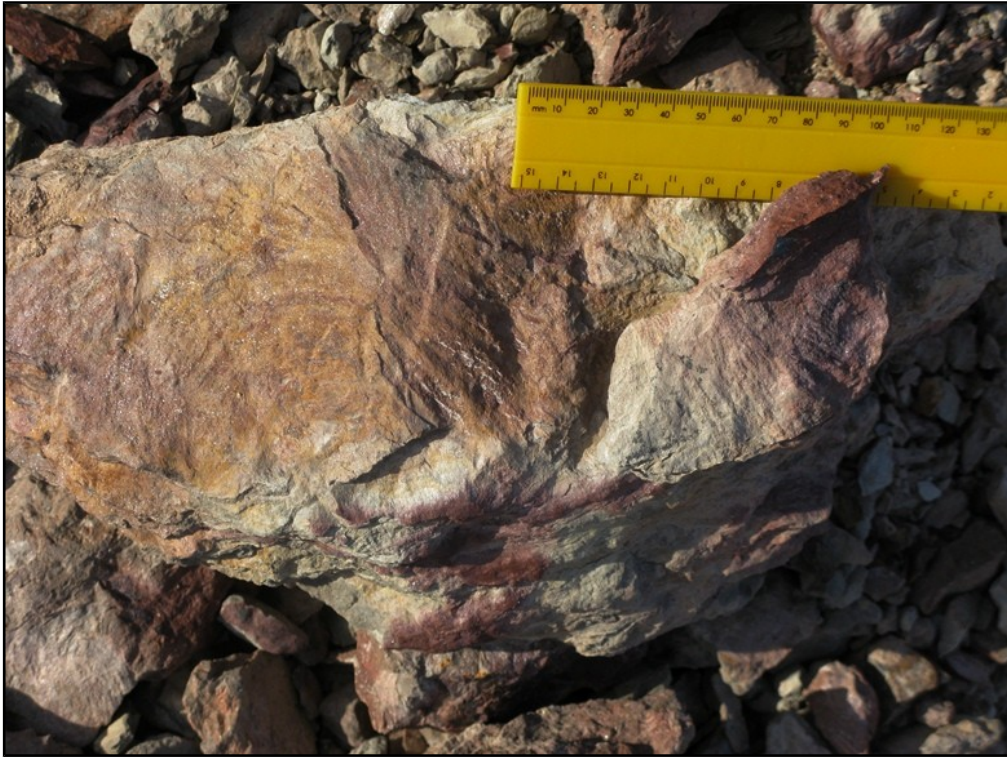


Fig. 7. Poorly preserved large examples of the helical spreiten burrow *Spirophyton* (Scale in cm and mm) within silty sandstones.



Fig. 8. Micaceous sandstone partings showing sections through various small scale vertical and oblique tubular burrows (Scale in cm).





**Fig. 9. Densely burrowed micaceous silty horizon within the Swartruggens Formation (Scale in mm and cm).**

## **5. CONCLUSIONS & RECOMMENDATIONS**

The DR01380/4.0/R/100 borrow pit is excavated into shallow marine sediments of the Mid to Late Devonian Swartruggens Formation of the lower Witteberg Group (and *not* the Early Carboniferous non-marine Waaipoort Formation as indicated on the geological map). This is one of the largest excavations into the Swartruggens succession available, but bedrock exposure here is very poor due to the mantle of recently excavated rock rubble. Apart from possible problematic “worm tubes” and transported vascular plant remains, body fossils are hitherto almost unknown within this rock unit. Only low diversity trace fossil assemblages, including poorly preserved helical burrows of the ichnogenus *Spirophyton*, are recorded within the present pit.

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## **6. ACKNOWLEDGEMENTS**

Ms Quahnita Samie of Vidamemoria Heritage Consultants, Cape Town, is thanked for commissioning this specialist study and for kindly providing the necessary background information. I am also very grateful to Ms Madelon Tusenius for logistical support and assistance with these borrow pit projects.



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## **8. 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 for SAHRA and HWC. Dr Almond is an accredited member of PSSA and AHP (Association of Professional Heritage Assessment 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 borrow pit 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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