

# **DAMKOPPIE HOUSING DEVELOPMENT, BEAUFORT WEST (WESTERN CAPE): PALAEOONTOLOGICAL IMPACT ASSESSMENT**



**View northwest from Damkoppie development site towards Nuweveld Escarpment**

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## 1. SUMMARY

The east-west ridge of the Damkoppie at Beaufort West is built of potentially fossiliferous fluvial sediments of the Late Permian Abrahamskraal Formation (Beaufort Group, Karoo Supergroup). These have been baked and reinforced by unfossiliferous intrusive dolerites of the Karoo Dolerite Suite (Early Jurassic). Due to superficial drift, exposure of the Beaufort Group – and especially of the palaeontologically more significant mudrock units - is currently rather poor. The only fossils recorded during the present scoping study were unidentifiable fragments of disarticulated, rolled tetrapod bones and poorly preserved invertebrate burrows from channel sandstones of the Poortjie Member (*Priesterognathus* Assemblage Zone).

Potentially interesting fossil specimens of tetrapods, vascular plants and trace fossils are quite likely to be exposed during excavations into fresh Beaufort Group bedrock (especially overbank mudrocks) during development. Before this starts, the responsible ECO should inspect the palaeontological displays at the Karoo National Park, Beaufort West, to gain experience in recognising Karoo fossils. The position of any obvious finds of fossil material found during development should be accurately recorded by the ECO on a 1: 250 000 map / aerial photo or with a GPS. Where practicable, fossil specimens, together with the surrounding rocky matrix, should be carefully collected, labeled and handed over to a professional palaeontologist for examination. However, should substantial articulated skeletal material be discovered, the ECO should inform Heritage Western Cape so that the site can be inspected and, if necessary sampled, by a professional palaeontologist. Fossil specimens that are not of research interest could be usefully donated to the Karoo National Park for educational purposes.

## 2. INTRODUCTION & PALAEOLOGICAL BACKGROUND

A housing development comprising some 80 *erven* has been proposed for the north-facing slopes of the Damkoppie at Beaufort West, Western Cape featuring scenic views across an artificial dam onto the Nuweveld Escarpment to the north (See front page). The Damkoppie is an east-west trending ridge up to 894m high asl that runs along the southern margin of the Beaufort West / Springfontein Dam at the northeast corner of town (1: 50 000 topographical map 3222BC Beaufort West; **Figure 1**). A somewhat dilapidated monument commemorating the Republic Festival of 1971 is situated towards the western extremity of the ridge, but no other substantial structures are present within the development footprint. Informal brickworks have been established in the clay-rich alluvial *vlaktes* to the east of the Beaufort West Dam. This area of the Beaufort West Municipal Commonage was the subject of a recent environmental management plan with detailed geological contributions from Dr D. Cole (Council for Geoscience, Bellville, May 2007).

The vegetation on the Damkoppie is Nama Karoo bossieveld with quite a high grassy component. Woody emergents include *Senegalia karoo*, *Carissa haematocarpa*, *Grewia robusta*, *Thesium lineatum*, and *Cadaba aphylla*. There are healthy populations of conservation-worthy succulents (eg *Euphorbia multiceps*, *Euphorbia stellispina*), though invasive alien cactus (*Opuntia* sp. cf *O. imbricata*) is clearly an rapidly developing problem.

Since the Damkoppie development area is underlain by potentially fossiliferous bedrock of the Late Permian Beaufort Group (Karoo Supergroup), a palaeontological impact assessment was commissioned by Herr Zwingli Holzapfel (Airpark Beaufort West (Pty) Ltd) as part of a more comprehensive heritage impact study by Jonathan Kaplan of the Agency for Cultural Resource Management (ACRM). A short (6 hour) field scoping study of bedrock exposures was carried out on 15 April 2008.

Background information on the geology and palaeontology of the Beaufort West area has been presented in the recent scoping report for the Karoo National Park by Almond (2006; see also Cluver 1978, MacRae 1999, McCarthy & Rubidge 2005 for readable accounts of Karoo vertebrate palaeontology). The Damkoppie area lies within a sandstone-rich zone of the lower Beaufort Group (**Abrahamskraal Formation**) known as the **Poortjie Member** that has recently been dated radiometrically to 260 Ma (Wuchiapingian Stage of the Late Permian). This stratigraphic unit is characterised palaeontologically by fossils of the *Pristerognathus* Assemblage Zone. This important terrestrial biota is dominated by various therapsids (“mammal-like reptiles”) such as the moderate-sized therocephalian carnivore *Pristerognathus* as well as several gorgonopsian predators / scavengers and herbivorous dicynodonts (Keyser and Smith 1979, Rubidge 1995, 2005). There are also large, rhino-sized herbivorous reptiles (*Bradysaurus* spp.), crocodile-like temnospondyl amphibians (*Rhinesuchus*), palaeoniscoid fish, vascular plant fossils of the *Glossopteris* Flora (fossil wood, leaves etc) and various trace fossils, including invertebrate burrows and tetrapod trackways.

Most fossils in the *Pristerognathus* Assemblage Zone are found in the softer-weathering mudrock facies (floodplain sediments) - usually only exposed on steeper hill slopes and in stream gullies - and are often associated with pedogenic limestone nodules or calcretes (Smith 1993a, Rubidge 1995). The mudrocks lie between the more resistant-weathering channel sandstones, which in the Poortjie Member display a distinctive “golden yellow” tint. Fossil skeletal remains also occur in the lenticular channel sandstones, especially in



intraformational lag conglomerates towards the base, but are usually very fragmentary and water-worn (“rolled bone”).

Bones and teeth of Late Permian tetrapods have been collected in the Beaufort West area since at least the 1820s (MacRae 1999) and this region remains a focus of palaeontological research in the Great Karoo. For example, an important Late Permian palaeosurface, preserving a wide range of sedimentary structures and trace fossils (arthropod trackways, worm burrows, fish trails *etc*), situated in the Beaufort West townlands to the southeast of town has been studied by Smith (1993b). Selected fossil sites recorded within the *Priesterognathus* Assemblage Zone / Poortjie Member in the Beaufort West area by Keyser and Smith (1979) are also indicated on the 1: 250 000 geological sheet 3222 Beaufort West published by the Council for Geoscience, Pretoria. The Fossil Trail and Interpretive Centre at the Karoo National Park are useful educational resources illustrating Great Karoo fossil heritage for schools and the general public.

### 3. KEY GEOLOGICAL & PALAEOLOGICAL SITES IN THE DAMKOPPIE REGION

The location of the Damkoppie study area is indicated on the map in **Figure 1**. The Damkoppie ridge is elevated above the vlaktes surrounding the base of the Nuweveld Escarpment at Beaufort West because of its reinforced “backbone” of closely-spaced channel sandstones of the Poortkie Member (Abrahamskraal Formation) and, more particularly, a substantial N-inclined sill of dolerite (**Karoo Dolerite Suite** of Early Jurassic age,  $183 \pm 2$  Ma). The sill has baked, and further hardened, the adjacent Beaufort Group mudrocks and sandstones to dark, splintery hornfels (“lydianite”) and (meta)quartzite respectively.

Most of the study area is covered with rocky colluvial drift – predominantly weathered dolerite and tough, hornfelsed sandstone – so good exposures of the underlying Beaufort Group sediments are very limited. During the present scoping study all substantial areas of exposed bedrock – indicated on the aerial photograph in **Figure 2** - were examined for fossils. Brief notes on each site are given below. Fragmentary tetrapod fossils and poorly preserved trace fossils were found only at one site (A) but were not collected since the specimens are of very limited research or educational value. It is likely that more valuable fossil material will be exposed by excavations into fresh Beaufort Group bedrock during the course of development (See recommendations, Section 4 below).

#### **Site A: Low ridge of Beaufort Group channel sandstones**

These tough, well-jointed, medium-grained buff sandstones form an obvious step or low *krans* at c. 870m asl running east-west across the eastern third of the Damkoppies development area (**Figure 3**). Current ripples and cross-bedding are common in the sandstones. Purplish mudrocks beneath are poorly exposed beneath the channel sandstone in this area. Fallen scree blocks of sandstone beneath the ridge display thin intraformational breccio-conglomerates largely composed of rounded to angular reddish mudflakes, with subordinate calcrete nodules. They are associated with occasional fragments of tetrapod bone (eg **Figures 4, 5**;  $32^{\circ} 20' 47.4''$  S,  $22^{\circ} 35' 38.5''$  E, 866m asl). Irregular hypichnial casts are probably washed out invertebrate burrows of the continental *Scoyenia* or *Termitichnus* Ichnofacies (**Figure 6**; eg  $32^{\circ} 20' 47.2''$  S,  $22^{\circ} 35' 37.8''$  E, 867m

asl). The bone fragments reach maximum dimensions of 6.5cm and are sometimes quite robust. They are probably unidentifiable, but some of them *might* belong to one of the commoner large therapsids of the *Priesterognathus* Assemblage Zone such as *Priesterognathus* itself.

#### **Site B: Shallow gullies in low-lying, near-shore portions of study area**

A series of shallow, north-south gullies running across the low-lying southern fringes of the dam expose reddish Beaufort Group mudrocks beneath the thin shaley alluvium in this area. No fossils were seen, but there is a healthy population of the distinctive, conservation-worthy succulent *Euphorbia multiceps* thriving here (32° 20' 44.2" S, 22° 35' 47.5" E, 864m asl.).

#### **Site C: Steep N-facing hillslope at dam shoreline west of picnic area**

Good exposures of purplish-brown and greenish, hackly-weathering Beaufort mudrocks are seen here. Thin, lenticular channel sandstones with basal mudflake conglomerates occur towards the base and closely stacked, amalgamated sandstones at the top of the slope (**Figure 7**; 32° 20' 45.3" S, 22° 35' 25.1" E, 862m asl). The mudrocks show clear bedding related to successive overbank flood events and pedoconcrete formation in palaeosols (eg partially-exposed calcrete nodules are well seen in wash and swash zone along the dam shoreline). Fine-grained flaggy sandstones (flat- and thin-bedded) with well-developed primary current lineation suggest an energetic crevasse splay origin. Other thicker sandstones are massive and represent river channel infills. No fossils were found, despite the excellent exposure of potentially fossiliferous overbank mudrocks here.

#### **Site D: Southern face of quarry area immediately east of spillover channel**

Good views of the main intrusive sill of Karoo dolerite in contact with underlying well-bedded, pale buff, baked Beaufort Group sandstones are seen here (**Figure 8**). The quarry area is floored with baked, vuggy sandstone (c. 0.5m thick) and mudrocks. No fossils were found.

#### **Site E: Steep hillslope and cliff exposures of Beaufort mudrocks in northwest corner of development area**

A low concrete wall at the southwest corner of the dam leads to a spill-over channel where natural erosion, artificial excavation and current scouring of superficial drift as well as Karoo dolerite has revealed good exposures of Beaufort Group bedrock (**Figure 9**). Purplish-brown and greenish-grey mudrocks, calcrete nodule horizons as well as thin buff sandstones are well seen here, but no fossils were found. A relict layer of laminated flood deposits, some 1m thick, is preserved at a high elevation well above the quarry floor.

#### **Site F: S- and W-facing cliff of Beaufort Group sediments just west of Monument**

Good exposures of tough, silicified quartzites are seen here forming a low cliff capped by a dolerite sill (**Figure 10**). The pale buff, baked Beaufort sandstones show characteristic rounded vugs and white speckling. No fossils were seen here.

#### 4. RECOMMENDATIONS

New or fresh bedrock exposures excavated during development may well be of palaeontological interest and should be inspected at intervals by the responsible Environmental Control Officer (ECO) before they are infilled or sealed. It is important that the ECO for this development, and preferably all construction staff, visit the Fossil Trail and Interpretive Centre in the Karoo National Park, Beaufort West at the start of operations so that they acquire some familiarity with the appearance of typical Beaufort Group fossil material.

Should loose fossils be encountered during excavations, they should be carefully collected, with adherent matrix where necessary, given a provisional reference number (e.g. marked on masking tape) and carefully wrapped in newspaper. It is *essential* that the locality where the fossil is found be accurately marked on a 1: 50 000 map or recorded by GPS; specimens without locality information are of limited scientific value. Fossils should be checked over by a professional palaeontologist at a later date. Some of this material may be of scientific interest - in which case it should be deposited ultimately in an approved repository (e.g. Iziko: South African Museum, Cape Town) – while other specimens may be of educational value and might be donated for display within the Karoo National Park (e.g. Interpretive Centre or Fossil Trail).

If well-articulated skeletons are encountered during construction, they should *not* be informally excavated since this will almost invariably lead to damage and loss of useful contextual information (e.g. taphonomy – data on mode of death and burial of animals). If feasible, the skeleton should be photographed (with scale), covered with a protective layer of loose gravel, and the site marked and carefully recorded (GPS / 1: 50 000 map / aerial photograph). The Environmental Control Officer should inform Heritage Western Cape so that the specimen can be examined and, if necessary, professionally excavated by a palaeontologist.

#### 5. ACKNOWLEDGEMENTS

Mr Jonathan Kaplan of ACRM is thanked for facilitating this palaeontological study. I am grateful to Herr Zwingli Holzapfel of Airpark Beaufort West (Pty) Ltd for commissioning the report, as well as for outstanding hospitality at the guesthouse Haus Holzapfel in Beaufort West.

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## 7. FIGURES

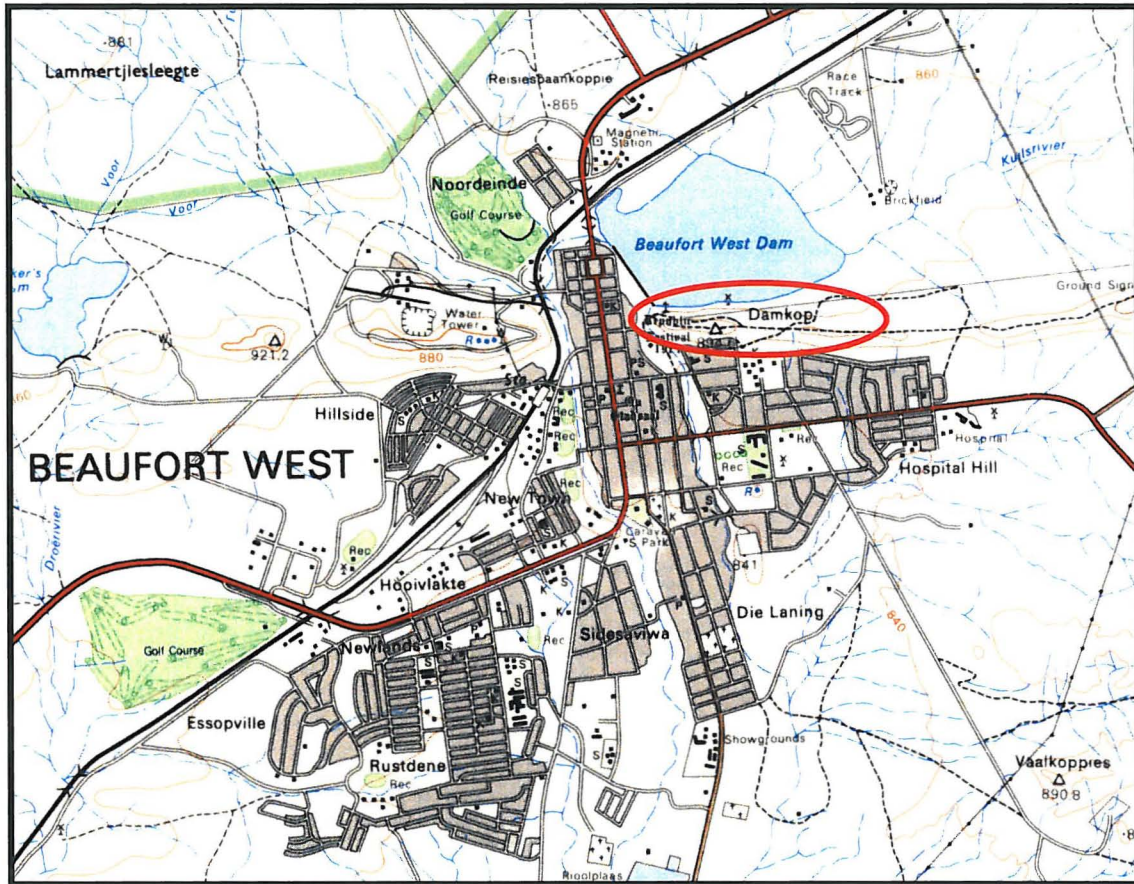


Figure 1. Location of Damkoppies development site on southern margin of Beaufort West Dam, Beaufort West (Western Cape). Extract from 1: 50 000 sheet 3222BC (Chief Director of Surveys & Mapping, Private Bag, Mowbray).





**Figure 2. Aerial view of Damkoppie development site on southern margin of Beaufort West Dam showing main sites of bedrock exposure examined for palaeontological heritage (A-F).**





**Figure 3. Low ridge of Poortjie Member channel sandstone in eastern portion of development area. Sandstone scree blocks below ridge contain rolled bone fragments and trace fossils (see Figs. 4-6 below).**



**Figure 4. Rolled bone fragment (4cm max. diameter) in mud pellet channel conglomerate, Site A.**





**Figure 5. Rolled bone fragment (6.5cm max. diameter) in sparse mud pellet channel conglomerate, Site A.**



**Figure 6. Washed out hypichnial trace fossils (probably stuffed invertebrate burrows) on sole of sandstone bed, Site A.**





**Figure 7. Good exposures of potentially fossiliferous Beaufort Group overbank mudrocks and channel sandstones, Site C.**



**Figure 8. Contact between thick inclined dolerite sill and thermally metamorphosed Beaufort Group channel sandstones, Site D.**





**Figure 9.** Good exposures of Beaufort Group overbank mudrocks and pedogenic calcretes at Site E.



**Figure 10.** Well-exposed bedrock at western end of Damkoppie ridge showing overbank mudrocks (1) and baked channel sandstones (2) of the Late Permian Beaufort Group, Early Jurassic intrusive dolerite sill (3), as well as geologically recent flood deposits (4).