

Palaeontological Desktop Evaluation of the Blackwood Solar Energy Facility, Boshof District, FS Province.

Report prepared for
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Executive Summary

- At the request of Savannah Environmental Consultants, a Palaeontological Desktop Assessment was carried out at the proposed new 75MW Blackwood Solar Energy Facility located in the Boshof district in the western Free State Province.
- The desktop evaluation indicates that construction activities will primarily impact on Quaternary-age aeolian deposits, surface calcretes, dolerite outcrop, as well as older Ecca sediments of the Prince Albert Formation.
- The south-eastern part of the affected area lies within an outcrop area of Ecca Group sediments, which are considered being of low to moderate palaeontological significance.
- The rest of the site's surface area is covered by superficial deposits made up of Quaternary-aged calcretes and aeolian sands. The older surface calcretes (*Qc*) developed as valley sediments on pediments and flat surfaces during arid periods is generally favourable for the preservation of fossil remains.
- A series of palaeontologically sensitive pans are located south and north of the affected area and form part of a natural drainage line adjoining the nearby Modder River to the south.
- These pan dunes are, along with Quaternary alluvial deposits of the Modder River, considered to be of potentially high palaeontological significance.
- The likelihood of palaeontological impact resulting from new overhead power lines constructed between the affected area and the Boundary substation is considered moderate to high, as the new power line may impact on potentially sensitive palaeontological areas, including pans and associated drainage lines. This option will require a Phase 1 impact assessment.
- The likelihood of palaeontological impact resulting from excavations and ground moving activities into surface calcretes and Ecca sediments during the

construction phase of the solar facility and its associated infrastructure, is considered moderate to high without on-site inspection of the affected area. A Phase 1 Impact Assessment is recommended to substantiate the findings of the desktop study.

Introduction

At the request of Savannah Environmental Consultants, a Palaeontological Desktop Assessment was carried out at the proposed new 75MW Blackwood Solar Energy Facility located in the Boshof district in the western Free State Province (**Fig.1**). The development involves the construction of a photovoltaic solar facility and associated infrastructure that will connect to the ESKOM grid via a loop in loop out configuration on the site, or alternatively, via a power line to the Boundary Substation, situated approximately 20 km away to the north (**Fig 2**). A project of this kind is likely to significantly impact on potentially fossil-bearing strata during the construction phase, although not during the operational phase.

The survey is required as a prerequisite for new development in terms of the National Environmental Management Act and is also called for in terms of the National Heritage Resources Act 25 of 1999. The task involved identification of possible paleontological sites or occurrences in the proposed zone, an assessment of their significance, possible impact by the proposed development and recommendations for mitigation where relevant.

Methodology

The desktop study provides an assessment of known and potential palaeontological heritage within the study area, with recommendations for mitigation where considered necessary. The assessment is based on existing field data and published scientific literature. The geology represented within the study area was determined from published literature and associated geological maps.

Description of the Affected Area

Locality data

1:50 000 topographic map 2824 DD Beaconsfield

1:250 000 geological map 2824 Kimberley

General site coordinates: 28°54'54.16"S 24°57'27.95"E

The site is located on the farm Pandamsfontein 1593, about 25 kilometres southeast of Kimberley on the N8 national road leading to Petrusburg (**Fig. 3**). The area mostly comprises relatively flat terrain, punctuated by dolerite hills towards the east of the site.

Geology

The geology of the region has been described by Bosch (1993). The area in question is underlain by sediments of widely different geological ages (**Fig. 4**, portion of 1: 250 000 scale geological map 2824 Kimberley, Council for Geoscience, Pretoria, 1991) (Cole 2005; Johnson *et al.* 2006; Partridge *et al.* 2006). From oldest to youngest, the geology in and around the affected area is made up of early Permian Ecca shales (Prince Albert Formation, *Ppr*), Jurassic dolerite intrusions (*Jd*, Karoo Dolerite Suite), Quaternary calcretes, surface limestones, calcified pan dunes (lunettes) (*Qc*) and aeolian sands (*Qs*). The wind-blown sands represent the latest geological phase and are made up of the characteristically red-brown Kalahari sands (Hutton sands).

The geological map indicates that, except for dolerite intrusions, the affected area lies within an outcrop area of the Prince Albert Formation (Ecca Group) that is mainly covered by Quaternary-age surface deposits made up of surface calcretes and a thick mantle of aeolian sand.

Background

Karoo Fossils

Fossils from the early Permian Prince Albert Formation (Ecca Group) occur mostly in the lowermost part of the formation (Cole 2005). Invertebrates, fish, coprolites, wood and spores are described from a section between 10 and 16 m above the base of the formation near Douglas (McLachlan & Anderson 1973), while sponge spicules, wood and *Glossopteris* leaves, as well as a variety of trace fossils, were reported from borehole cores taken near Hopetown, Britstown and the Kimberley - Hertzogville area (Cole & McLachlan 1994).

Karoo Dolerites

Dolerite, in the form of dykes and sills, is common throughout the region and intruded into Karoo Supergroup rocks as large volumes of Drakensberg lavas during the Jurassic Period. Being more resistant to weathering than the surrounding sedimentary rocks it gave rise to the characteristically flat-topped hills in the region. Dolerites are not palaeontologically significant and can be excluded from further consideration in the present evaluation.

Late Cenozoic Deposits

Quaternary-age surface deposits in the region can be highly fossiliferous in places, especially those that are directly related to fluvial environments along major river courses, spring areas or pans (**Fig 5**). Fossil assemblages, individual specimens and fossilized hyena burrows have been found preserved in Late Pleistocene alluvial sediments of the Modder River (Broom 1909 a, b; Cooke 1955; Churchill *et al.* 2000; Rossouw 1999, 2000, 2006). These assemblages are frequently made up of an assortment of mammalian bones and teeth. Numerous fossil sites, often associated with Middle Stone Age artefacts, have been found eroding out of Pleistocene alluvial terraces and dongas along the Modder River between Glen (near Bloemfontein) and Ritchie, southwest of Kimberley. These fossils revealed the existence of a number of open grassland adapted herbivores (*Equus capensis*, *Megalotragus priscus*, *Homoiocerus antiquus*, *Antidorcas bondi* and *Equus lylei*). The abundance of these different sized grazers in the Free State is a reflection of the availability of abundant seasonal grassland and offers strong evidence of a stable and sustainable grassland ecosystem in the central interior of South Africa thousands of years ago.

Intrusive features such as fossilized hyena burrows are sometimes also located away from the Modder River valley, within the calcified pan dunes of deflation frequently found in the region (Scott & Brink 1991). When these types of pans were formed, the prevailing winds blew unconsolidated material (aeolian sands) into newly formed lunettes on the lee side of the deflation hollows which occasionally provided a locus for hyena activities (burrows) and prehistoric human habitation in the past. In addition, spring deposits, such as at Florisbad (northwest of Bloemfontein) and Baden Baden

(north of Dealesville), may contain Pleistocene vertebrate fossils and plant microfossils. (Brink 1987; Scott & Rossouw 2005) (**Fig. 6**).

Significance of Impacts and Recommendations

The south-eastern part of the affected area lies within an outcrop area of Ecca Group sediments, which are considered being of low to moderate palaeontological significance. The rest of the site's surface area is covered by superficial deposits made up of Quaternary-aged calcretes and aeolian sands. The older surface calcretes (*Qc*) developed as valley sediments on pediments and flat surfaces during arid periods is generally favourable for the preservation of fossil remains. A series of palaeontologically sensitive pans is located south and north of the affected area and form part of a natural drainage line adjoining the nearby Modder River to the south (**Fig. 7**). These pan dunes are, along with Quaternary alluvial deposits of the Modder River, considered to be of potentially high palaeontological significance.

Potential impacts of power lines

Option 1. Via a loop in loop out configuration on the site: The likelihood of palaeontological impact resulting from overhead power lines is considered **low** as the facility will connect to the ESKOM grid via **existing** power lines traversing the site.

Option 2. Via a new power line to the Boundary Substation: The likelihood of palaeontological impact resulting from new overhead power lines constructed between the affected area and the Boundary substation is considered moderate to high, as the new power line may impact on potentially sensitive palaeontological areas, including pans and associated drainage lines (**Fig. 8**). This option will require a Phase 1 impact assessment to assess potential palaeontological impact of a proposed new power line situated between the Blackwood PV solar facility and the Boundary substation.

Potential impacts of the solar facility & its infrastructure

It is expected that infrastructure development will involve installation of multiple photovoltaic panels, underground cables, new buildings and access roads, resulting in construction activities extending over a relatively large surface area. The desktop

evaluation indicates that construction activities will primarily impact on Quaternary-age aeolian deposits (*Qs*), surface calcretes (*Qc*), dolerite outcrop (*Jd*), as well as older Ecca sediments of the Prince Albert Formation (*Ppt*). Dolerites are not palaeontologically significant, but the likelihood of palaeontological impact resulting from excavations and ground moving activities into surface calcretes and Ecca sediments during the construction phase of the solar facility and its associated infrastructure, is considered moderate to high without on-site inspection of the affected area. A site visit (Phase 1 Impact Assessment) is recommended to substantiate the findings of the desktop study.

References

- Bosch, P.J.A. 1993. Die geologie van die gebied Kimberley. Toeligting van Blad 2824. *Geologiese Opname*, Pretoria 60 pp.
- Brink, J.S. 1987. The taphonomy and palaeoecology of the Florisbad spring fauna. *Palaeoecology of Africa* 19: 169-179.
- Churchill, S.E. *et al.* 2000. Erfkroon: a new Florisbad fossil locality from fluvial contexts in the western Free State, South Africa. *South African Journal of Science* 96: 161-163.
- Cole, D.I. and McLachlan, I.R. 1994. Oil shale potential and depositional environment of the Whitehill Formation in the main Karoo Basin. *Report Geol. Surv. S. Afr.* 1994-0213.
- Johnson, M.R., *et al.* 2006. Sedimentary rocks of the Karoo Supergroup:461-499. In Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J. eds (2006) *The geology of South Africa*. Geological Society of South African and Council for Geoscience, Pretoria.
- McLachlan I.R. and Anderson, A.M. 1973. A review of the evidence for marine conditions in southern Africa during Dwyka times. *Palaeontologia Africana* 15: 37 – 64.
- Partridge, T.C., Botha, G.A. and Haddon, I.G. (2006) Cenozoic deposits of the interior. In Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J. eds. *The geology of South Africa*: 585-604. Geological Society of South African and Council for Geoscience, Pretoria.

Rossouw, L. 2006. Florisian mammal fossils from erosional gullies along the Modder River at Mitasrust Farm, Central Free State, South Africa. *Navorsinge van die Nasionale Museum* 20: 145-162

Scott, L. & Brink, J.S 1991. Quaternary palaeoenvironments of pans in central South Africa: palynological and palaeontological evidence. *SA Geographer* 19: 22-34

Scott, L, & Rossouw, L. 2005 Reassessment of botanical evidence for palaeoenvironments at Florisbad, South Africa. *South African Archaeological Bulletin* 60: 96-102.

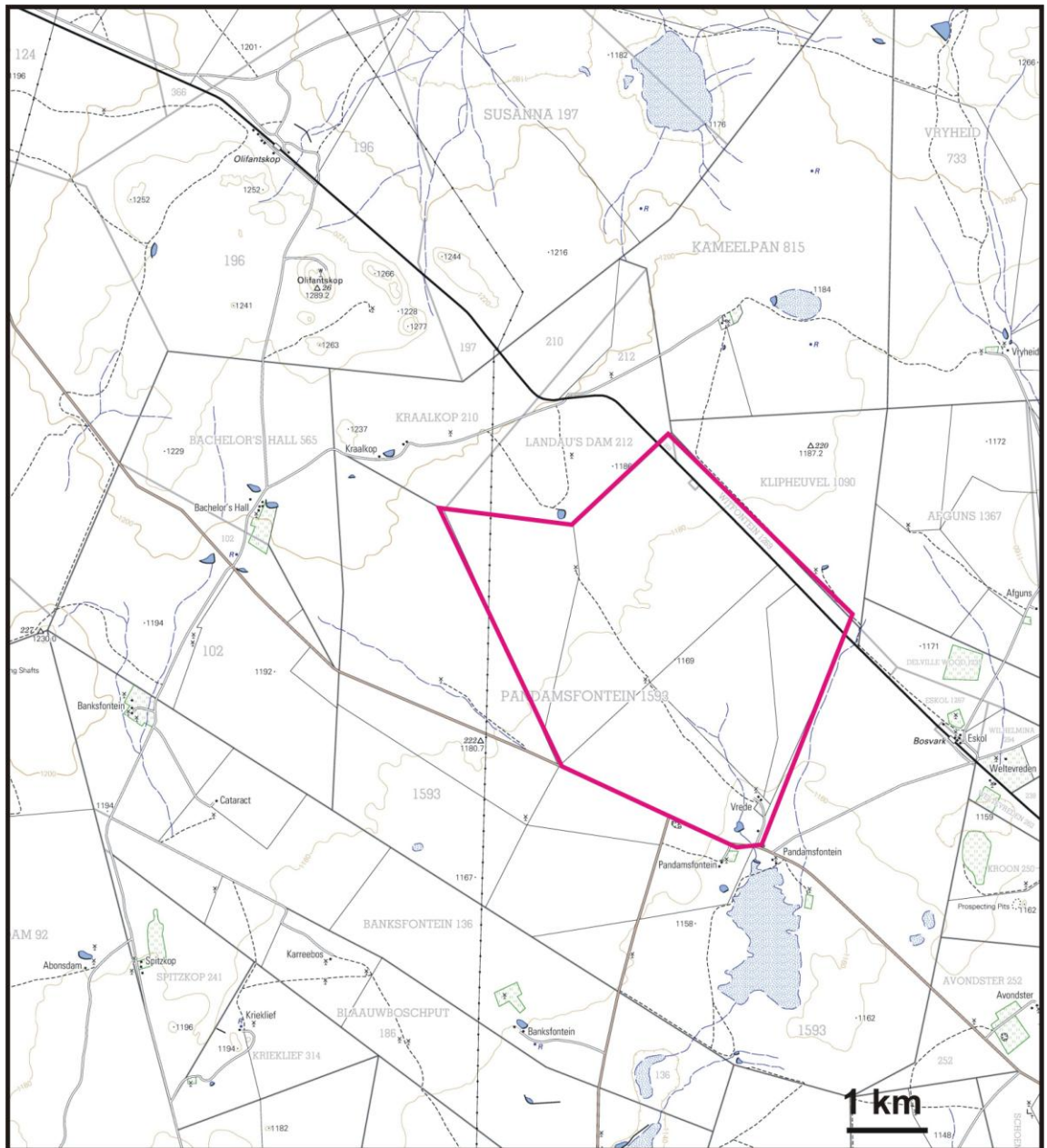


Figure 1. Map of the proposed Blackwood PV solar facility development (portion of 1:50 000 scale topographic map 2824 DD Beaconsfield).

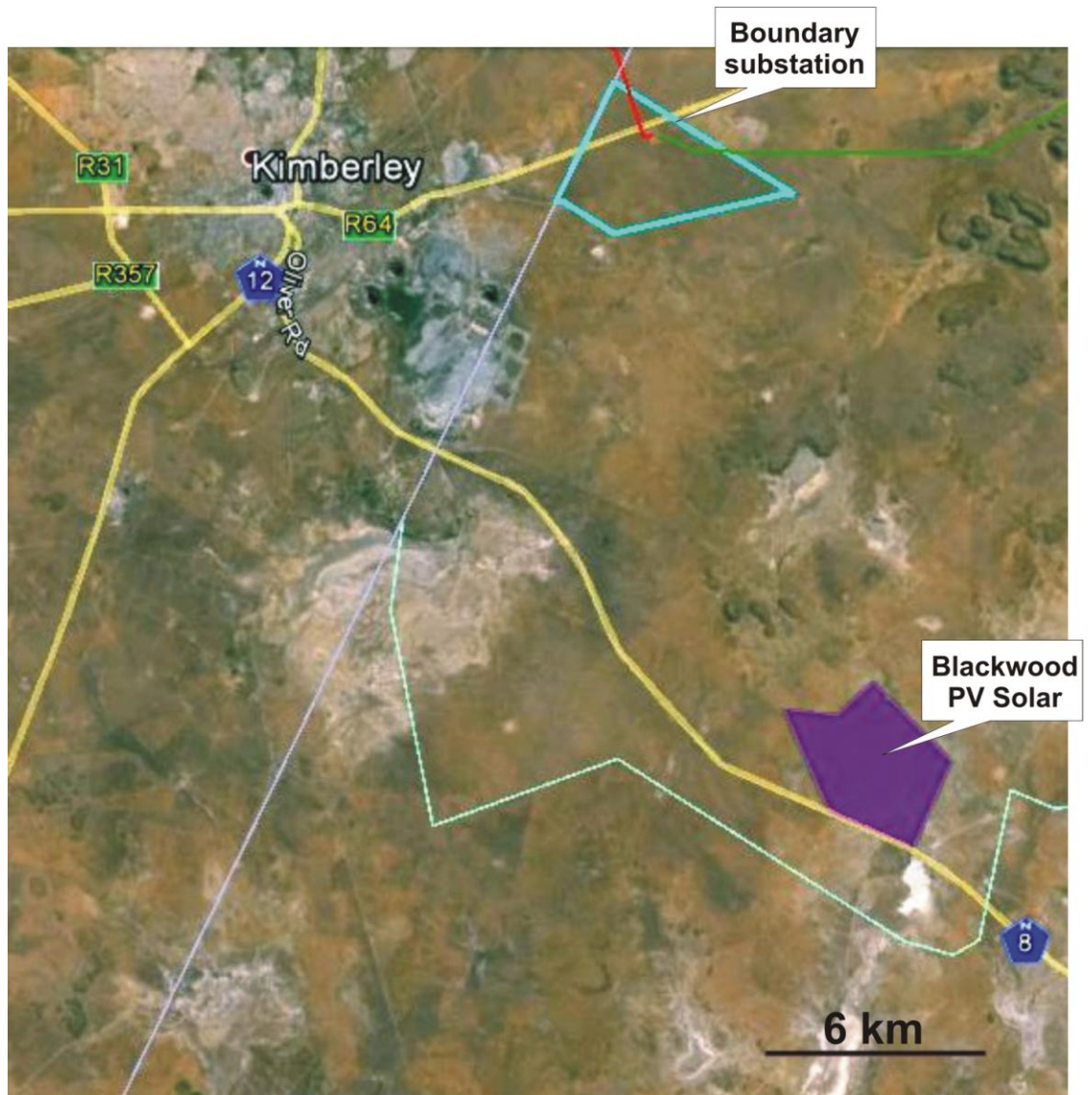


Figure 2. The development involves the construction of a photovoltaic solar facility and associated infrastructure that will connect to the ESKOM grid via a turn in and out configuration on the site, or alternatively, via a power line to the Boundary Substation, situated approximately 20 km away to the north.



Figure 3. The site is located about 10 kilometres southeast of Kimberley on the N8 national road leading to Petrusburg.

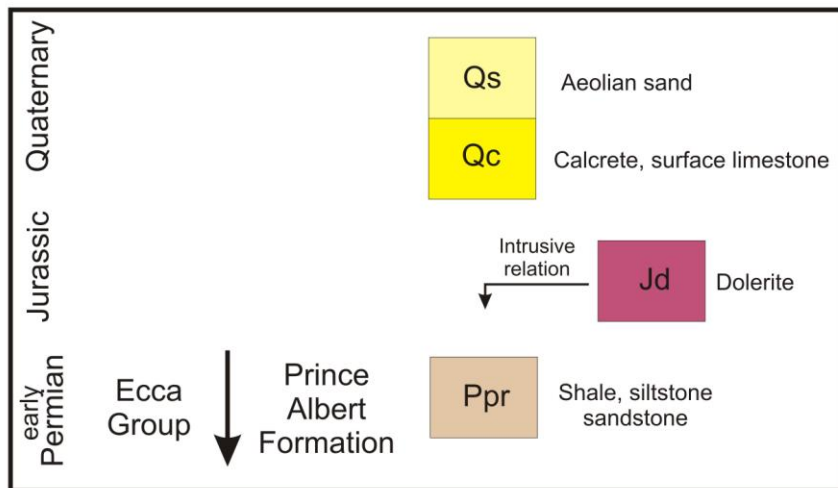
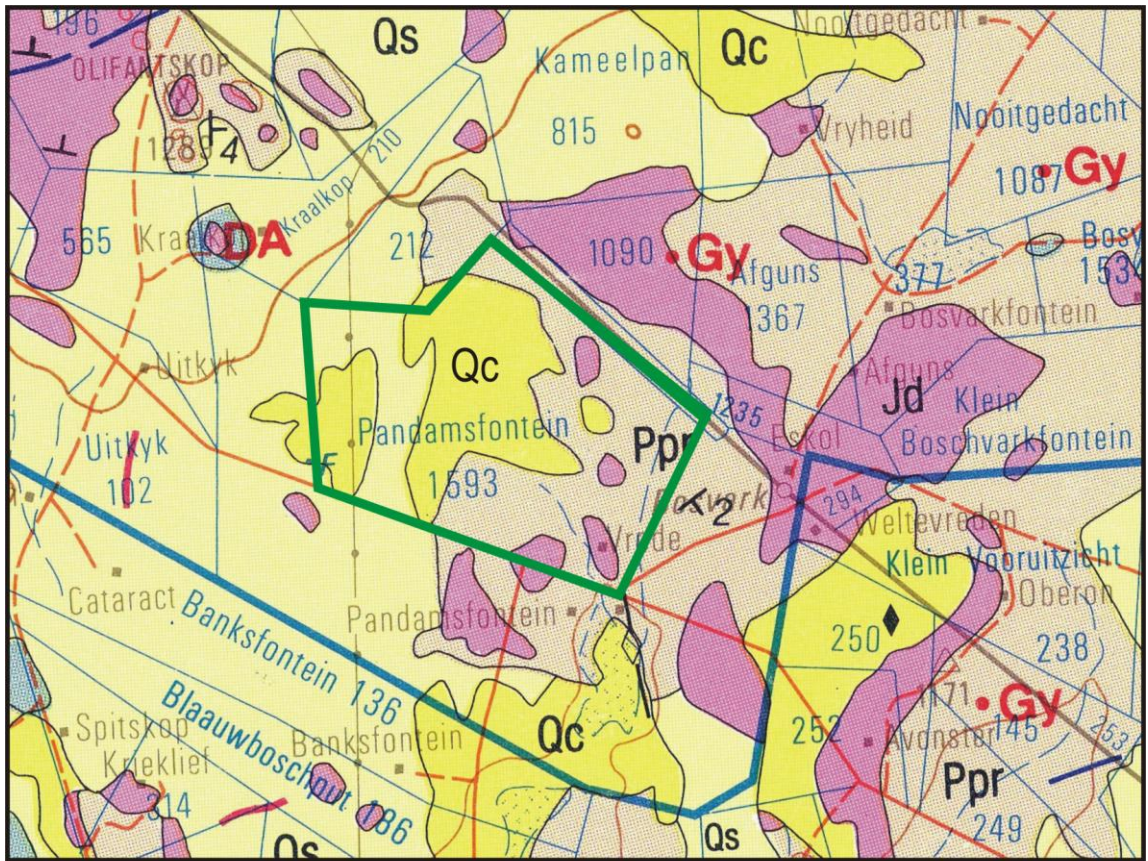


Figure 4. Portion of 1 : 250 000 scale geological map of the study area. From oldest to youngest, the geology in and around the affected area is made up of Permian Ecca shales (Prince Albert Formation, *Ppr*), Jurassic dolerite intrusions (*Jd*, Karoo Dolerite Suite), Quaternary calcretes, surface limestones, calcified pandunes (*Qc*) and aeolian sands (*Qs*) (Kalahari Group).



Figure 5. Examples of Quaternary palaeontological sites recorded along the Modder River drainage between Bloemfontein and Ritchie. A metacarpal bone of the extinct giant buffalo (*Homoiocerus antiquus*) found near Mitasrust (A), fossiliferous overbank deposits at Erfkroon (B), calcereized fossil remains and associated MSA stone tools, Modder River drainage near Perdeberg (C&D).

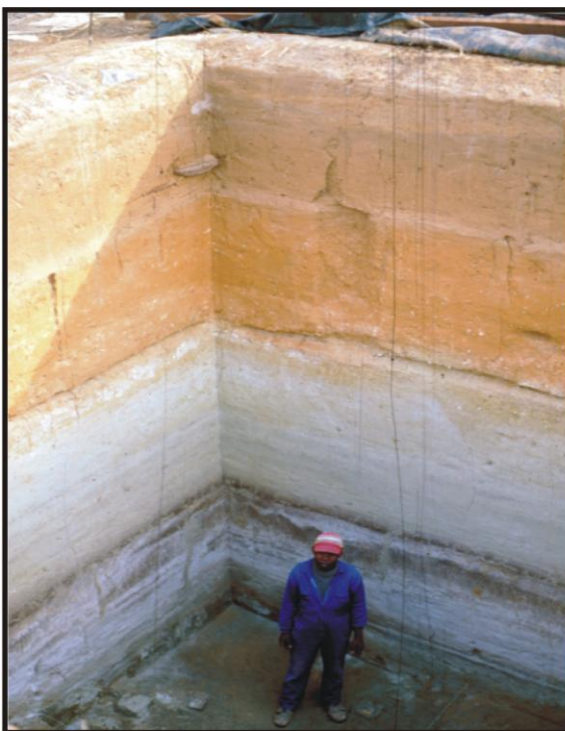


Figure 6. Excavations at the Florisbad Spring near Soutpan (above) and a view of the fossil-bearing spring deposits at Baden Baden near Dealesville (below).



Figure 7. The affected area is located near a series of potentially sensitive pans that forms part of a natural drainage line adjoining the nearby Modder River to the south.

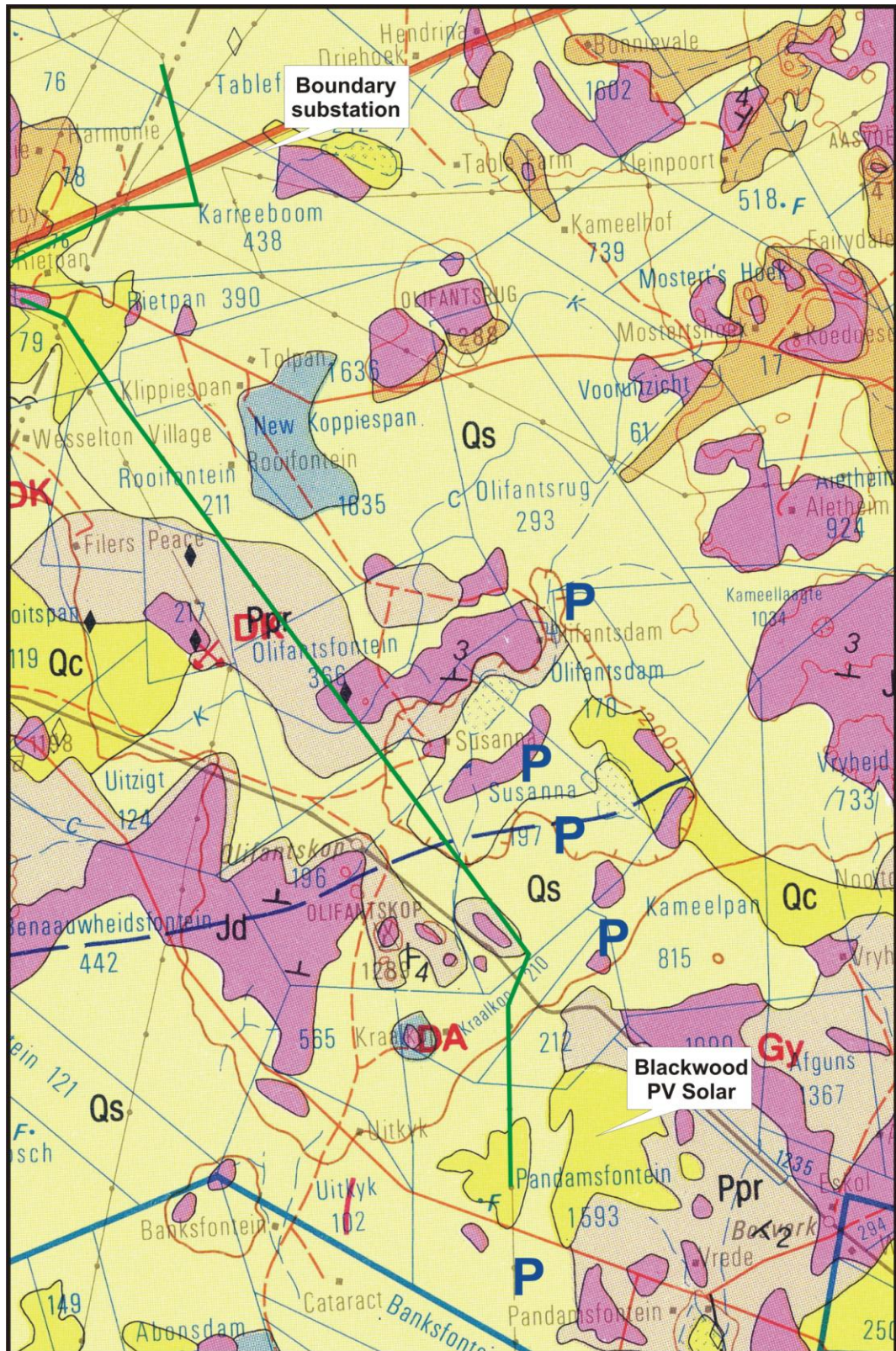


Figure 8. A new power line between the Blackwood development and the Boundary¹⁷ substation may impact on potentially sensitive palaeontological areas, including pans and associated drainage lines.