

PALAEONTOLOGICAL ASSESSMENT: RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES

Proposed hydropower station on the Orange River near Kakamas, Northern Cape Province (DEA Ref. No. 12/12/20/2012)

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Executive summary

The proposed hydropower station development on the River Orange to the east of Kakamas is underlain by ancient Precambrian igneous and metamorphic bedrocks that do not contain fossils as well as by sparsely fossiliferous alluvial sediments of Quaternary to Recent age. In view of the very low palaeontological sensitivity of the study region, no further specialist studies are considered necessary for this project as far as fossil heritage is concerned. None of the alternative development options is preferred on palaeontological heritage grounds. Should substantial fossil remains (e.g. vertebrate bones and teeth) be encountered during construction, the responsible ECO should inform SAHRA at the earliest opportunity to consider possible mitigation measures.

1. Project description

The company Kakamas Hydro Electric Power (KHEP) (previously Mulilo Renewable Energy) is proposing to construct a 12 megawatt hydropower station on the Orange River on the farm Zwartbooisberg, approximately 12 km east of the small town of Kakamas, Northern Cape Province (Figures 1 and 2).

According to the draft Basic Assessment Report prepared by Aurecon, Cape Town, the hydropower station project entails the following main components:

- An **abstraction point** above Neus weir for the abstraction of water at a maximum rate of some 105 cubic metres per second (m^3/s);
- An **aqueduct** approximately 1.3 – 2.2 km long that would transfer the water from the weir to the turbine hall (*i.e.* the power station) downstream on Neus Island, or along the northern bank of the river;
- A **hydropower station** to be constructed on Farm No. 502 Portion 1 (Neus Island) and Portions 4 and 5 of Farm 475;
- Two **22 kV distribution lines** up to 1.0 and 2.2 km in length to connect the hydropower station with the Eskom electricity grid. The first line would cross from the island to connect to existing electricity distribution infrastructure on Farms 1489, 1490, 4 and 27 on the southern bank of the Orange River, south of the island. The second line would cross Farm no. 475 Portion 5 and connect to the existing electricity distribution infrastructure on Farm no. 469 Portion 43, east of the island. The lines would be a 22 kV A-frame line type. These consist of 11 m poles planted 1.8 m deep (*i.e.* only 9.2 m of the pole is above ground).

Six layout alternatives are being considered for the proposed hydropower station, four on Neus Island and two on the northern bank of the river (Figure 1). Alternatives 1 - 4 would start at the centre point of the Neus weir and cross Neus Island to four alternative turbine hall locations. Alternative 5 would start approximately 50 m upstream of Neus weir on the northern bank of the river. It would bypass the weir wall before cutting across the northern branch of the river across Neus Island to 120 m west of Alternative 2's turbine hall. Alternative 6 (the preferred alternative) would start approximately 270 m upstream of Neus weir on the northern bank of the river and would follow the river before re-connecting with the river approximately 100 m downstream of the island. Each alternative for the proposed hydropower station route would have two electricity distribution lines.

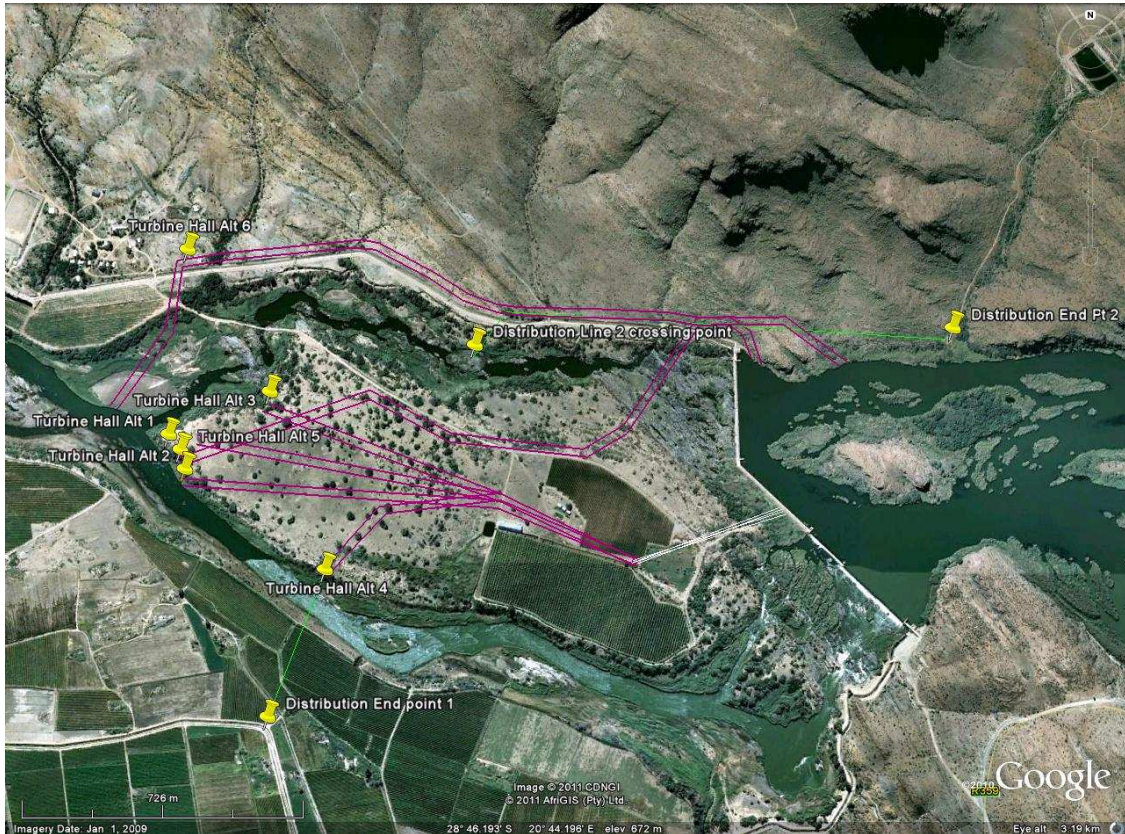


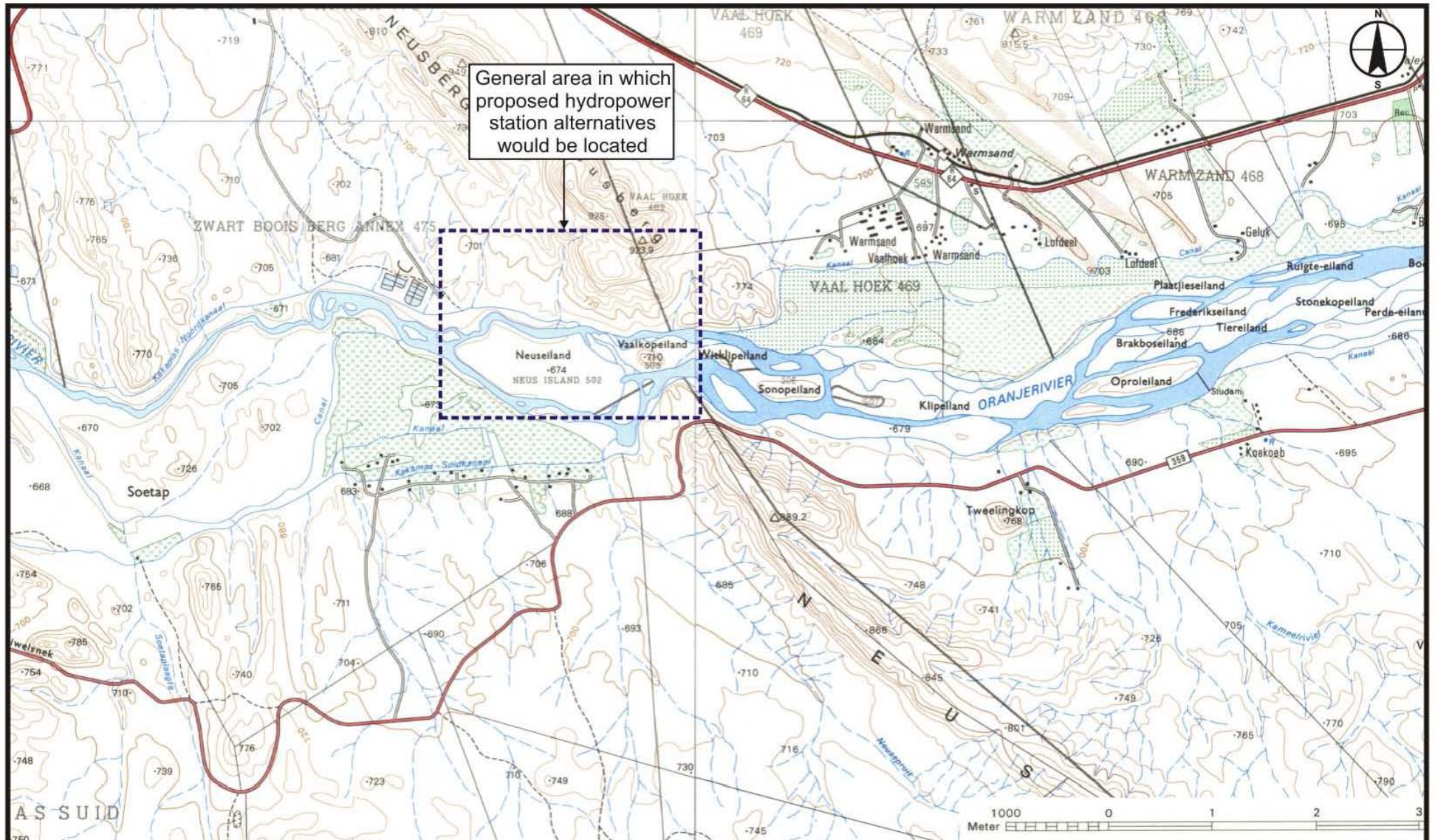
Figure 1. Satellite image showing alternatives 1 to 6 for the proposed hydropower station on the Orange River at Neus, c. 12 km to the east of Kakamas, Northern Cape (Image kindly provided by Aurecon, Cape Town).

Alternatives 1-4 of the proposed hydropower station would consist of the following components:

- Temporary upstream caisson (construction only)
- Abstraction point
- Aquaduct (including an open or closed canal, head pond and penstock)
- Turbine hall/power house
- Temporary downstream caisson (construction only)
- Switchroom

As Alternatives 5 and 6 are routed through different terrain they are comprised of variations of the components described above, namely:

- Temporary upstream caisson (construction only);
- Abstraction point including an abstraction weir;
- Aquaduct and siphon (including an open or closed canal, head pond and penstock);
- Turbine hall/power house;
- Temporary downstream caisson (construction only); and
- Switchroom.



General area in which proposed hydropower station alternatives would be located



Location of the proposed hydropower station near Kakamas, Northern Cape

SCALE
As shown

Figure 1

Figure 2 (Previous page). Map showing location of the proposed hydropower station c. 12km east of Kakamas (Image kindly provided by Aurecon, Cape Town).

2. Geological and palaeontological context

The geological setting of the proposed hydropower station is shown on the 1: 250 000 geology sheet 2820 Upington (Fig. 3; Moen 2007).

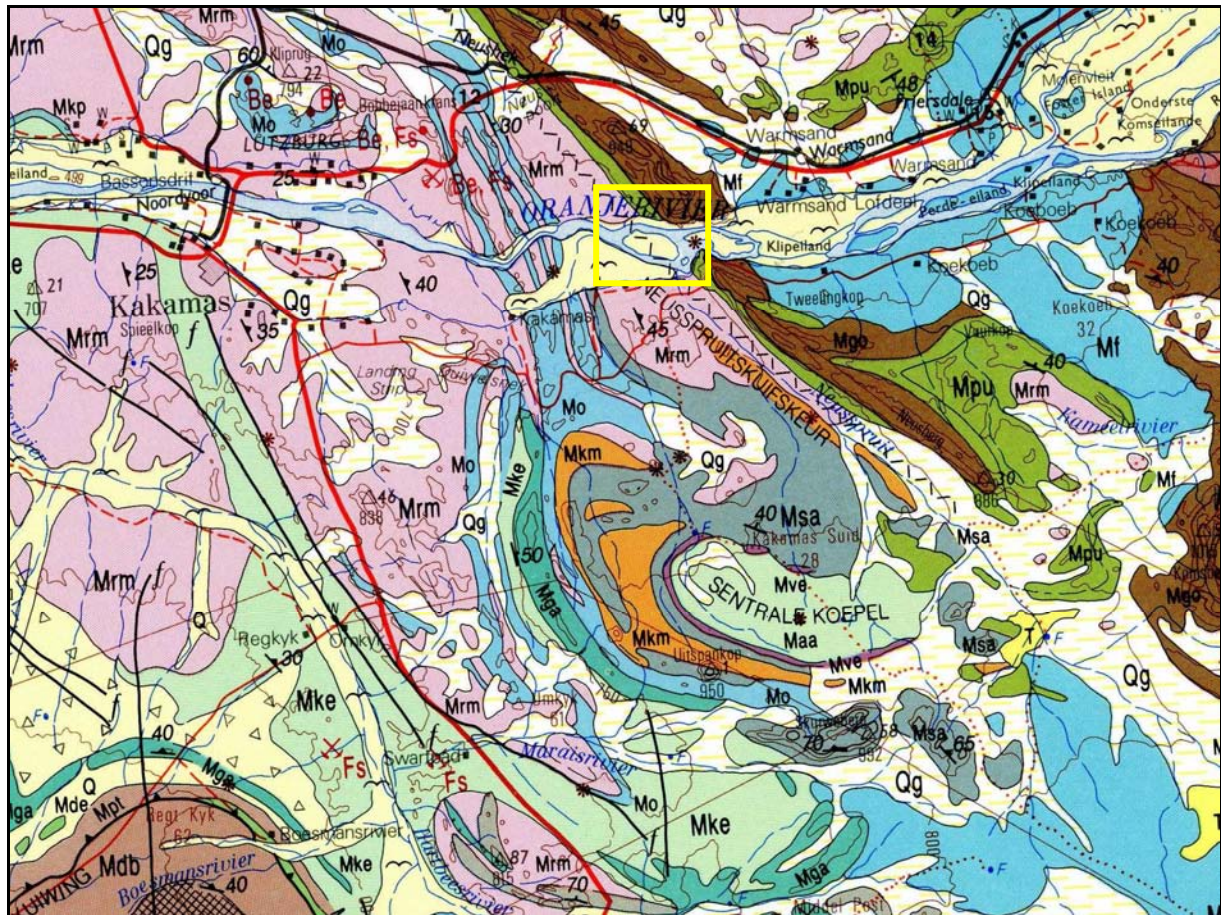


Fig. 3. Extract from 1: 250 000 sheet 2820 Upington (Council for Geoscience, Pretoria) showing the outline geology of the study area (yellow rectangle) along the Orange River c. 12 km east of Kakamas, Northern Cape. Units Mgo (brown), Mpu (green) and Mrm (pink) are unfossiliferous Precambrian basement rocks of the Namaqua-Natal Metamorphic Province. Pale yellow areas along the Orange River, including Neus Island, are Quaternary to Recent alluvial sediments of low palaeontological sensitivity.

The proposed power station development is largely situated above ancient Precambrian (Mokolian / Mid Proterozoic) basement rocks of the **Namaqua- Natal Metamorphic Province** that have been incised by the Orange River in the Kakamas region (Slabbert *et al.* 1999, Moen 2007). These igneous and high grade metamorphic rocks (granites, gneisses *etc*) are about 1.2-1.3 billion years old and are completely unfossiliferous (Almond & Pether 2008).

Fine-grained **alluvial silts** of Quaternary age and similar-aged to somewhat older (perhaps late Neogene) **terrace gravels** are present along the Orange River, including on several islands. The gravel terraces are situated at elevations of 20 to 45m above present river level (Moen 2007). Comparable gravels along several sectors of the Orange River drainage system have yielded important fossil remains (bones, teeth) of Pleistocene mammals but so far records from the study area are sparse to non-existent. Fossil remains that might potentially be encountered during

excavations through fine-grained and coarser alluvium along the River Orange as well as smaller tributary drainage courses include:

Bones and teeth of wide range of vertebrates, including mammals (e.g. teeth & bones of mastodont proboscideans, rhinos, bovids, horses, micromammals), reptiles (crocodiles, tortoises), ostrich egg shells, fish, freshwater and terrestrial molluscs (unionid bivalves, gastropods), crabs, trace fossils (e.g. termitaria, horizontal invertebrate burrows, stone artefacts), petrified wood, leaves, rhizoliths, diatom floras, peats and palynomorphs (Hendy 1984, Klein 1984, Partridge *et al.* 2006, Almond 2008, Almond & Pether 2008 and refs. therein).

Superficial (drift) sediments away from the main drainage courses along the pipeline route largely comprise surface gravels (mainly sheetwash and deflation deposits, scree breccias derived from local elevated exposures of bedrock), reddish aeolian sands and near-surface calcretes, the last especially over lime-rich bedrock. The red sands can be assigned to the upper part of the **Kalahari Group (Gordonia Formation)** of late Caenozoic (Neogene / Quaternary) age and the remaining drift sediments and probably of a similar, geological youthful age. Although fossil remains are occasionally encountered in these terrestrial units – for example calcretised root casts, termitaria, ostrich egg shells, land snail shells (Almond 2008, Almond & Pether 2008 and refs. therein) - they are sparsely distributed and occur over a very wide area, so the footprint of this project on palaeontological heritage preserved within these non-alluvial drift units will be very slight.

3. Conclusion

In view of the low palaeontological sensitivity of both the ancient Precambrian bedrocks as well as the geologically recent superficial sediments along the Orange River in the Kakamas region, the proposed hydropower station and associated infrastructure are not considered to pose a significant threat to palaeontological heritage. Pending any significant new fossil discoveries in the area, no further specialist studies are considered necessary for this development project.

All South African fossil heritage is protected by the National Heritage Resources Act, 1999. Should substantial fossil remains (e.g. vertebrate bones and teeth) be encountered during construction, the responsible ECO should inform SAHRA at the earliest opportunity to consider possible mitigation measures.

4. References

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5. 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 APHAP (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 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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