BRIEF PALAEONTOLOGICAL IMPACT ASSESSMENT

(Desktop Study)

PROPOSED UPINGTON SOLAR THERMAL PLANT 2 AND PROPOSED UPINGTON SOLAR THERMAL PLANT 3

On additional parts of Portion 3 of the Farm McTaggarts Camp 453

Gordonia District, Northern Cape

By

John Pether, M.Sc., Pr. Sci. Nat. (Earth Sci.)

Geological and Palaeontological Consultant
P. O. Box 48318, Kommetjie, 7976
Tel./Fax (021) 7833023
Cellphone 083 744 6295
jpether@iafrica.com

Prepared at the Request of

Savannah Environmental (Pty) Ltd

PO Box 148
Sunninghill, 2157
Tel: +2711 234-6621
Fax: +2786 684 0547
Cell: 084 300 0660
www.savannahSA.com

For

Abengoa Solar Power South Africa (Pty) Ltd

24 October 2013

1. INTRODUCTION

This assessment has been prepared at the request of Savannah Environmental (Pty) Ltd. It is the part of the Heritage Impact Assessment in the EIA process being undertaken by Savannah Environmental for their client, Abengoa Solar Power South Africa (Pty) Ltd.

Abengoa is proposing the establishment of 2 additional Concentrating Solar Power (CSP) solar electricity generating facilities on Portion 3 of the Farm McTaggarts Camp 453, west of the town of Upington in the Northern Cape (Figure 1).

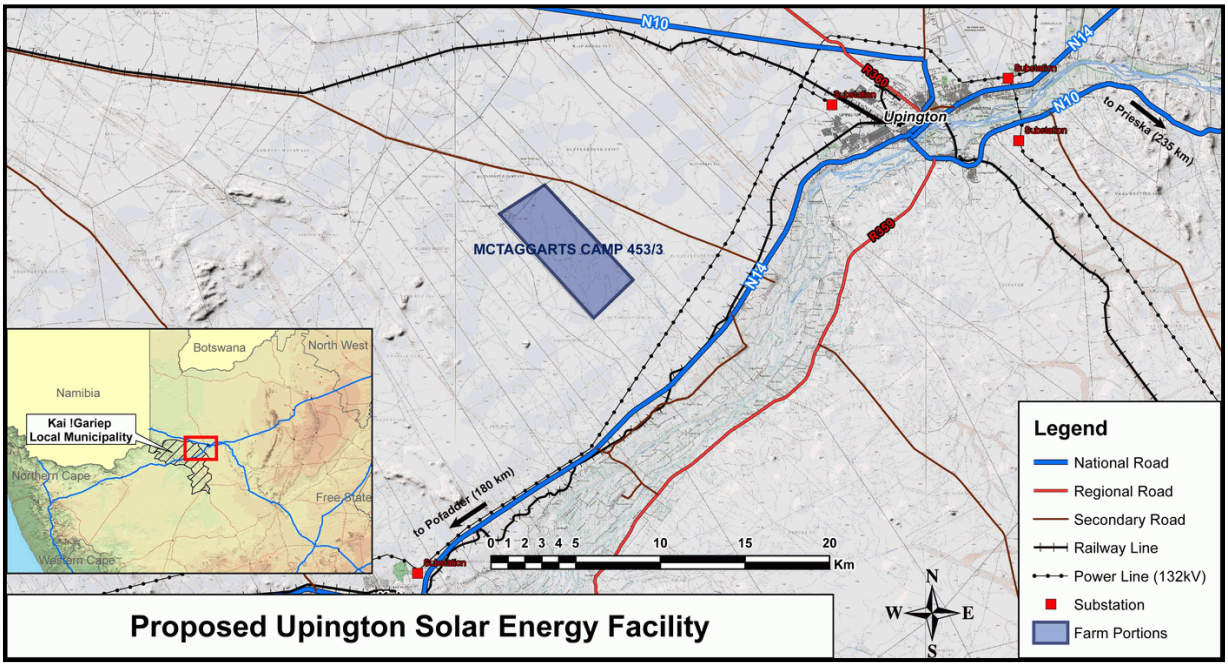


Figure 1: Portion 3 of McTaggerts Camp, site of the proposed Upington Solar Thermal Plants 1, 2 and 3.

Portion 3 of the Farm McTaggarts Camp 453 has been the subject of a previous brief PIA prepared for Savannah Environmental for the client Khi CSP South Africa (Pty) Ltd (Pether, 2010), namely the proposed Upington Solar Thermal Plant 1. This STP 1, which is under construction, occupies the southern part of the project area, while the proposed STP 2 and STP 3 will occupy the central and northern parts, respectively (Figure 2).

As the newly-proposed STPs 2 and 3 are also situated within the previously-defined project area, this brief PIA serves only to update the previous (STP 1) PIA with the new proposals, but the geology and palaeontological sensitivities are unchanged. Furthermore, separate PIAs for each STP are not required, as they do not differ with respect to their low fossil potential.

Both proposals involve 100 MW plants; the central STP is a Tower CSP and the northern a Trough CSP (Figure 2). Associated infrastructure includes access roads, plant substation, power line, water abstraction point and supply pipe line, water storage tanks, packaged waste treatment plant, lined evaporation ponds, salt storage tanks, auxilliary fossil fuel boilers and work shop and office buildings.

This Palaeontological Impact Assessment (PIA) assesses the probability of palaeontological materials (fossils) being uncovered in the subsurface and being disturbed or destroyed in the process of making excavations. The main purposes are to:

- Outline the nature of possible palaeontological heritage resources in the subsurface of the affected area.
- Suggest the mitigatory actions to be taken with respect to the occurrence of fossils during the construction phase.

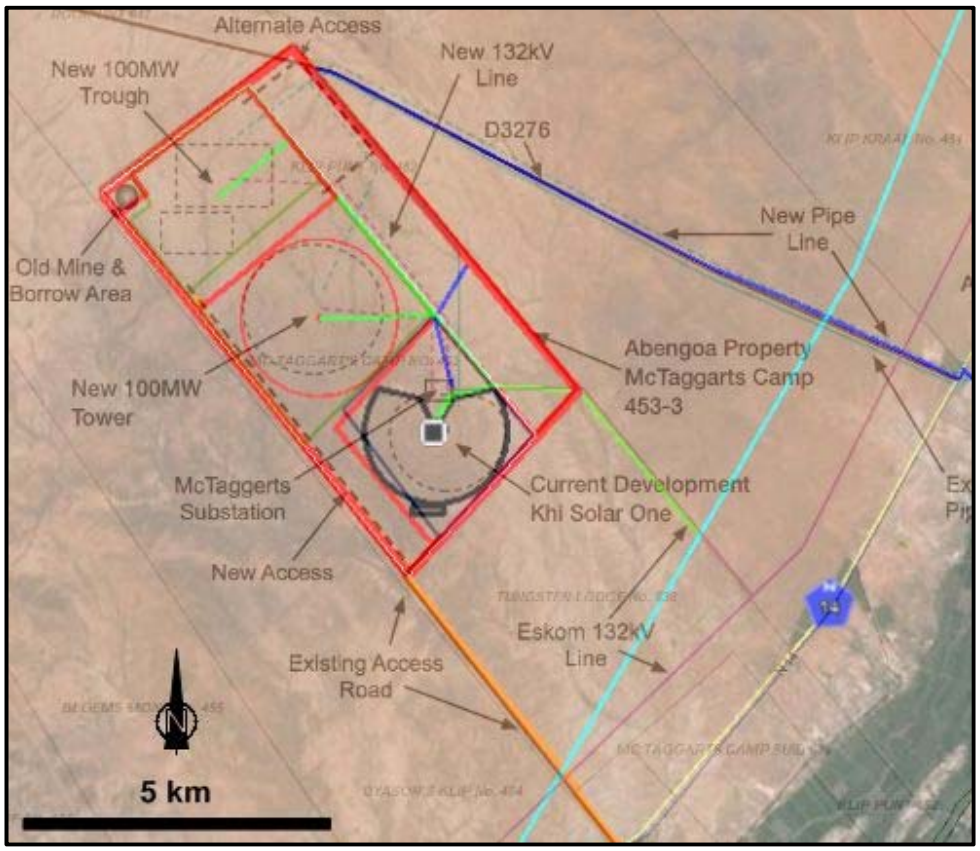


Figure 2: The Project Area, showing the locations of Khi STP1 under construction and the proposed new STPs 2 and 3.

2. APPROACH AND METHODOLOGY

2.1 Available Information

The main information sources consulted are the 1:1 000 000 CGS Geological Map of South Africa, 1:250 000 Geological Sheet 2820 Upington and the relevant chapters in "The Geology of South Africa" (Johnson *et al*., (eds.), 2006). Other references are cited in the normal manner and included in the References section. Specific details of geological sections of the the bedrock-mantling deposits in the area are not readily available. No subsurface geotechnical investigation reports of the site are available.

2.2 Assumptions and Limitations

It is not possible to predict the buried fossil content of an area other than in general terms. In particular, the important fossil bone material is generally sparsely scattered in most deposits and much depends on spotting this material as it is uncovered during digging (i.e. by monitoring excavations).

Details of bulk earth works required for the installations are not available.

2.3. Palaeontological Heritage Management

The rescue of fossils or sampling of fossil content (palaeontological mitigation) cannot usually be done prior to the commencement of excavations for infrastructure and foundations. Palaeontological interventions happen once the EIA process is done, the required approvals have been obtained, and excavation of the bulk earth works is proceeding. The intent of palaeontological mitigation is to sample the *in situ* fossil content and describe the exposed, pristine stratigraphic sections.

The action plans and protocols for palaeontological mitigation must therefore be included in the Environmental Management Plan (EMP) for the Construction Phase of the project.

4. GEOLOGICAL SETTING

4.1. Local Geology

The project area is situated between 50 to 100 metres above the local level of the Gariep (Orange) River, at 820-870 m above sea level, on very low gradients sloping mainly to the southwest (Figure 2).

The geological setting is the Namaqua-Natal Metamorphic Province, Namaqua Sector, Areachap Terrane (Cornell *et al*., 2006), where metasediments, gneisses and granites, ranging in age from 2000-1000 Ma, comprise an unfossiliferous bedrock (Figure 3). This

bedrock is exposed beneath Kalahari Group sedimentary deposits, where the latter has been eroded away along drainages.

The area is on the edge of the Kalahari Basin where the Kalahari Group sedimentary deposits are thin. Basal pebbly sands of the Eden Formation, deposited in braided streams (Haddon, 2000), may overlie the bedrock.

Calcretes of the Mokalanen Formation are widely developed and have formed in a variety of sediments such as the deposits of ephemeral streams, pans, colluvium and windblown sands. The calcrete thickness is sometimes considerable and represents polyphase development, mainly since the late Miocene/early Pliocene ~5 Ma (Haddon, 2000; Partridge *et al*., 2006).

Overlying the calcretes are red aeolian sands classic of the Kalahari, nowed termed the Gordonia Formation. In places there are deposits accumulated in pans, beneath and within the aeolian sequence.

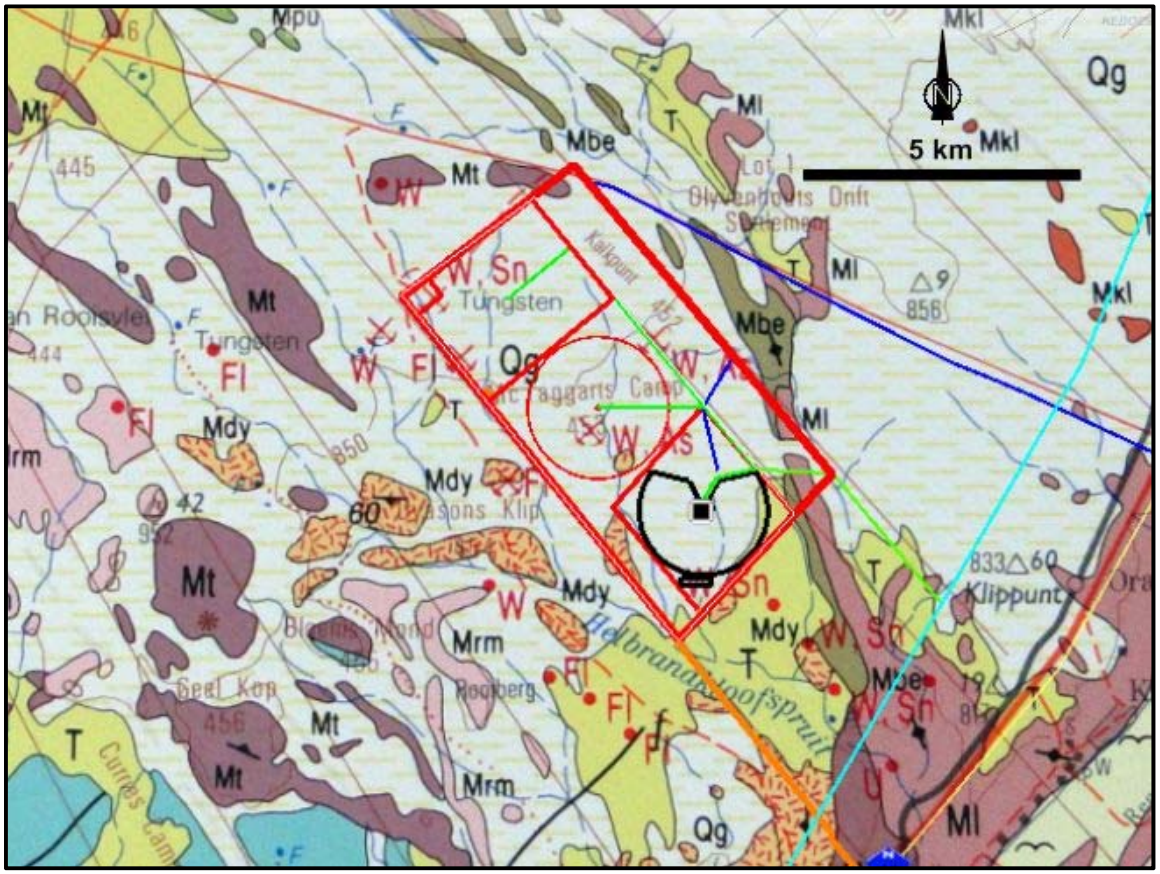


Figure 3: Geology of the Project Area. Extract from Geological Sheet 2820 Upington, Council for Geoscience.

Legend for Figure 3

KALAHARI GROUP: Basal gravels, sandy and pebbly calcretes and overlying aeolian sands.
Represented by the **Gordonia Formation – Qg**.

LOUISVALE GRANITE: Ml - Grey, well-foliated, medium-grained, locally porphyritic adamellitic granite with abundant xenoliths.

BETHESDA FORMATION: Mbe - Biotite-rich and pelitic gneisses, muscovite-biotite schist, subordinate amphibolite and calc-silicate rocks.

DYASONS KLIP GNEISS: Mdy - Brown-weathering porphyroblastic to megacrystic gneiss (intrusive).

RIEMVASMAAK GNEISS: Mrm - Pink-weathering granular or augen quartz-feldspar gneiss.

BIESJE POORT GROUP: Mt - Toeslaan Formation gneisses.

4.2. Expected Palaeontology

The Kalahari sediments and calcretes have low fossil potential, but possibility of fossils being encountered in diggings cannot be totally excluded. The fossils contexts are those of ephemeral watercourses and aeolian settings, particularly interdune areas where local ponding or pans developed.

Most of the fossils in the aeolianites are associated with particular contexts, particularly buried, stable surfaces (palaeosurfaces) where time has permitted bones to accumulate. The common fossils include shells of land snails, fossil tortoises, ostrich incl. egg fragments, sparsely scattered bones etc. “Blowout” erosional palaeosurfaces may carry fossils concentrated by the removal of sand by the wind. Hollows between dunes (interdune areas) are the sites of ponding of water seeping from the dunes, leading to the deposits of seeps and pans/vleis. Being water sources, such may be richly fossiliferous. Most of fossils obtained from the Kalahari deposits have been from pans. Ephemeral watercourse deposits are poorly fossiliferous, but abraded bone fragments and loose teeth may occur sparsely in channel lags. Trace fossils are common in Kalahari Group sediments, particulary the burrow complexes and hive-like calcified nests made by termites.

5. APPLICABLE LEGISLATION

The National Heritage Resources Act (NHRA No. 25 of 1999) protects archaeological and palaeontological sites and materials, as well as graves/cemeteries, battlefield sites and buildings, structures and features over 60 years old. The South African Heritage Resources Agency (SAHRA) administers this legislation nationally, with Heritage Resources Agencies acting at provincial level.

According to the Act (Sect. 35), it is an offence to destroy, damage, excavate, alter of remove from its original place, or collect, any archaeological, palaeontological and historical material or object, without a permit issued by the South African Heritage Resources Agency (SAHRA) or applicable Provincial Heritage Resources Agency, *viz*. Heritage Western Cape (HWC).

Notification of SAHRA or the applicable Provincial Heritage Resources Agency is required for proposed developments exceeding certain dimensions (Sect. 38).

6. THRESHOLDS

The areal scale of subsurface disturbance and exposure exceeds 300 m in linear length and 5000 m^2 (NHRA 25 (1999), Section 38 (1)). It has therefore been assessed for heritage impacts (an HIA) that includes assessment of potential palaeontological heritage (a PIA).

For the evaluation of the palaeontological impact it is the extent/scale of the deeper excavations to be made that are the main concern, such as the foundations for the CSP central tower, foundation trenches for buildings, the trenches for connecting piping and cabling and water storage dams.

Plans showing the extent and depths of bulk earth works are not available yet. Notwithstanding, it is likely that significant sub-surface volumes will be disturbed and exposed.

7. SIGNIFICANCE

The fossil record from Kalahari deposits is very poor with respect to finds of fossil bones of vertebrates. Thus fossils finds will be of considerable scientific interest. Mitigation during the construction phase of the proposed project has the potential for discoveries that stand to have heritage/scientific benefits.

The significance of fossils that may be found involves:

- Significance for the history of the Kalahari deposits.
- Significance for the history of past climatic changes.
- Significance in the history of past biota and environments. Rescuing of fossil bones is very important. These may not necessarily represent species that we would expect nowadays. Modern analytical techniques such as stable isotopic analyses can reveal indications of diets and environmental conditions of the past.
- Associations of fossils with buried archaeological material and human prehistory.
- For radiometric and other dating techniques.
- Preservation of materials for the application of yet unforeseen investigative techniques.

8. NATURE OF THE IMPACT OF DEVELOPMENT EXCAVATIONS ON FOSSILS

Fossils are rare objects, often preserved due to unusual circumstances. This is particularly applicable to vertebrate fossils (bones), which tend to be sporadically preserved and have high value w.r.t. palaeoecological and biostratigraphic (dating) information. Such fossils are non-renewable resources. Provided that no subsurface disturbance occurs, the fossils remain sequestered there.

When excavations are made they furnish the "windows" into the past that would not otherwise exist and thereby provide access to the hidden fossils. The impact is positive for palaeontology, provided that efforts are made to watch out for and rescue the fossils. Fossils and significant observations will be lost in the absence of management actions to mitigate such loss. This loss of the opportunity to recover them and their contexts when exposed at a particular site is irreversible.

The status of the potential impact for palaeontology is not neutral or negligible.

Although terrestrial coversands are not generally very fossiliferous, it is quite possible that fossiliferous material could occur. The very scarcity of fossils makes for the added importance of them being sought.

There remains a medium to high risk of valuable fossils being lost in spite of management actions to mitigate such loss. Machinery involved in excavation may damage or destroy fossils, or they may be hidden in "spoil" of excavated material. Worse, they may simply be ignored as "Just another bone".

9. RECOMMENDATIONS

In view of the low fossil potential, monitoring of bulk earth works by a specialist is not justified.

Notwithstanding, the sporadic fossil occurrences are then particularly important and efforts made to spot them are often rewarded.

In order to spot the rare occurrences, it is very desirable to have the co-operation of the people "on the ground". By these are meant personnel in supervisory/inspection roles, such as engineers, surveyors, site foremen, etc., who are willing and interested to look out for occurrences of fossils. These personnel are also critical in informing excavator operators and manual workmen, whom being close to the sediments, would be more likely to spot smaller fossils.

It is recommended that a requirement to be alert for possible fossils be included in the EMP for the Construction Phase. This should include guidelines for potential finds and a reporting/action protocol for when finds are uncovered.

There is a local branch of the CGS (Geological Survey) in Upington. A local CGS geologist could be involved to inspect excavations and liaise with the ECO and an advising palaeontologist, in the event of possible finds.

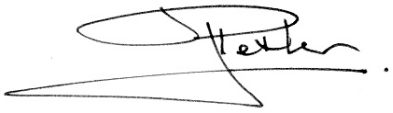
10. REFERENCES

Cornell D.H. *et al*. 2006. The Namaqua-Natal Province. In: Johnson, M. R., Anhaeusser, C. R. and Thomas, R. J. (eds.), *The Geology of South Africa*. Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria. 325-379.

Haddon, I.G. 2000. Kalahari Group Sediments (Chapter 11). In: Partridge, T.C. and Maud, R.R. (eds.). The Cenozoic of Southern Africa. *Oxford Monographs on Geology and Geophysics No. 40. Oxford University Press*: 173-181.

Partridge, T.C., Botha, G.A. & 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*. Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria. 585-604.

ZAF CGS 1:1M Bedrock Lithostratigraphy. http://portal.onegeology.org.



John Pether

24 October 2013