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**BRIEF PALAEOLOGICAL IMPACT ASSESSMENT  
PROPOSED SOLAR PV ENERGY FACILITY AND BATTERY ENERGY STORAGE SYSTEM  
REMAINDER OF ERF 2018, RIVERSDALE, HESSEQUA MUNICIPALITY, WESTERN CAPE**

FOR

**Agency for Cultural Resource Management (ACRM)**

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CLIENT

**SHARPLES ENVIRONMENTAL SERVICES**

APPLICANT

**HESSEQUA MUNICIPALITY**

**2 FEBRUARY 2024**

## SUMMARY

Hessequa Municipality proposes to establish a 10 MW Solar Energy Facility (SEF) and Battery Energy Storage System (BESS) of ~18 ha on Erf RE/2018 on the outskirts of Riversdale town.

The installation of a SEF and BESS does not involve major subsurface disturbance. Typically, the main excavations are the shallow trenches for connecting cabling, while the solar panel arrays are supported on driven posts or concrete sleepers and the transformers/inverters and BESS are located on concrete slabs.

The **upper Bokkeveld Group** bedrock occupies the southern portion of RE/2018 (Figure 2) and is comprised of marine shelf mudrock shales and thin sandstones of mid-Devonian age (~385 Ma). The northern part is underlain by the succeeding lowermost formation of the Witteberg Group, viz. the **Wagen Drift Formation** comprised of shallow-marine sandstones with interbedded mudrocks of late Devonian age (~375 Ma). The old “High Coastal Platform” is geomorphologically represented by the higher ground occupied by the **Grahamstown Formation silcretes** (Figure 2, Tg) and by the “**High-level terrace gravels**”.

The Bokkeveld Group in general is of high palaeontological sensitivity due to its unique fossil content (Figure 3), but in the Southern Cape coastal region it is tectonized and weathered to the extent that its constituent formations cannot be differentiated. Similarly, the fossil content of the Wagen Drift Fm. has been compromised. The Grahamstown Fm. silcrete rocks are very poorly fossiliferous. The residual gravels on the downwasted Grahamstown Fm and the High-level terrace remnant palaeosurfaces have been subjected to a long history of pedogenesis, fossils are very unlikely to be preserved and fossil finds are not reported.

**In conclusion, the construction of the SEF and BESS is not anticipated to have an impact on palaeontological heritage resources.**

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## 1 INTRODUCTION

Hessequa Municipality proposes to establish a 10 MW Solar Energy Facility (SEF) and Battery Energy Storage System (BESS) on the outskirts of Riversdale town. Sharples Environmental Services is conducting the Environmental Assessment process and has appointed ACRM to undertake the Archaeological Impact Assessment. This brief report is also part of the Heritage Impact Assessment and assesses the potential impact of the activity on palaeontological (fossil) heritage resources.

## 2 PROPOSED DEVELOPMENT

The proposed site of the SEF and BESS is on Erf RE/2018 which is situated just southwest of Riversdale and which is approached via the turnoff from the N2 to Vermaaklikheid (Heidelberg Rd.). The preferred location within Erf RE/2018 is in the south where the SEF will occupy approximately 18 ha (Figure 1), adjacent to an ESKOM Substation and will entail:

- Solar Photovoltaic (PV) Arrays
- Battery Energy Storage System (BESS): lithium ion, lithium phosphate or vanadium flow batteries.
- Inverters and Power Electronics.
- Grid connection to the electrical grid at the Riversdale municipal substation.

The SEF will be installed in phases;

- Phase 1: 4 MWp Solar PV plus 2 MWh BESS.
- Phase 2: 4 MWp Solar PV plus 2 MWh BESS.
- Phase 3: 2 MWp Solar PV plus 4 MWh BESS.

## 3 GEOLOGICAL CONTEXT

The scope of this assessment is the entire Erf RE/2018 in case alternative sites should be considered.

Erf RE/2018 is situated on the “High Coastal Platform”, thought to have been last occupied by the sea 50-40 million years ago (50-40 Ma) during the Eocene Epoch. The “High Coastal Platform” has subsequently been eroded down to form flattish-topped hills as remnants of the ancient coastal surface separated by the deeper dissections of the subsequent river valleys. The bedrock underlying the area is mainly exposed on the eroded valley flanks and consists of formations of the **Cape Supergroup** which were deposited into a subsiding basin, the Agulhas Sea, formed across the tip of future southern Africa when it was still embedded in the super-continent Gondwana. This great wedge of sediment, up to 8 km thick, is comprised of the deposits of wide fluvial braid-plains, succeeded by shallow-marine environments, and marine deep-water deposits further out in the Agulhas Sea (Thamm & Johnson 2006). Subsequently, between 280 and 230 Ma, the deposits in the Agulhas Sea underwent crustal tectonic compression from the south, squeezing the Cape Supergroup rocks upwards in a series of stacked thrusts, faults and folds to form the giant contortions of the Cape Fold Belt.

Of the Cape Supergroup rocks, the upper **Bokkeveld Group** occupies the southern portion of RE/2018 (Figure 2) and is comprised of marine shelf mudrock shales and thin sandstones of mid-Devonian age (~385 Ma) (Penn-Clarke *et al*, 2018). The northern part is underlain by bedrock of the succeeding lowermost formation of the **Witteberg Group**, viz. the **Wagen Drift Formation** comprised of shallow-marine sandstones with interbedded mudrocks of late Devonian age (~375 Ma).

With the rifting and breakup of Gondwana from ~160 Ma massive erosion of subcontinent proceeded, including erosion forming the coastal-plain bevels of the new coast. Just north of the Project Area is a fault-bound basin dating from rifting times, the Heidelberg Basin, which is filled with deposits of the Uitenhage Group, including the Enon Fm. conglomerates and the succeeding Kirkwood Fm. fluvial/river deposits.

The old “High Coastal Platform” is geomorphologically represented by the higher ground occupied by the **Grahamstown Formation** (Figure 2, Tg) and by the “**High-level terrace gravels**”.



**Figure 1. Location of the proposed Riversdale SEF.**

During the period 70 to 30 Ma the landscape was subjected to deep weathering due to prolonged periods of wet tropical climate which altered the bedrock and overlying sediments largely to kaolin clay, while the dissolved silica formed densely cemented layers in the water table zone, *i.e.* weathering-profile silcrete. The Grahamstown Fm. refers to these silicified gravels and sands, as well as silicified bedrock. The silcretes originally formed in the low-lying, waterlogged parts of the landscape, but subsequently resisted erosion and now mark the downwasted remnants of the ancient palaeosurface – known geomorphologically as “inverted topography”. The silcrete is quite discontinuous, varying from slab-like boulders to more extensive areas, while the general surface is covered with residual gravels.

Similarly, the “High-level terrace gravels” also represent the residual gravels on the downwasted remnants of the weathered ancient palaeosurface. Being persistent “fossil” features in the landscape the surfaces underwent many episodes of superimposed soil formation, notably the formation of lateritic soils



incorporating the residual deposits. The latter is a Fe-oxide enriched, cemented soil type, also called “koffieklip”, a favoured road material. It is often mistakenly referred to in the literature as “ferricrete”, which is not a soil, but an Fe-oxide-cemented spring deposit. There were multiple episodes of laterite genesis, shown by the different contexts of laterites in the coastal landscape. The laterites are fossil soils (palaeosols) and the most recent of these formed during the middle Quaternary, as is evident by the incorporation of Early Stone Age artefacts in laterite formed on ancient aeolianites. However, older laterites were also weathered, eroded and reworked as colluvia and were then re-cemented. A warm, sub-humid to humid climate with a distinct dry season and a wet season is commonly associated with laterite formation.

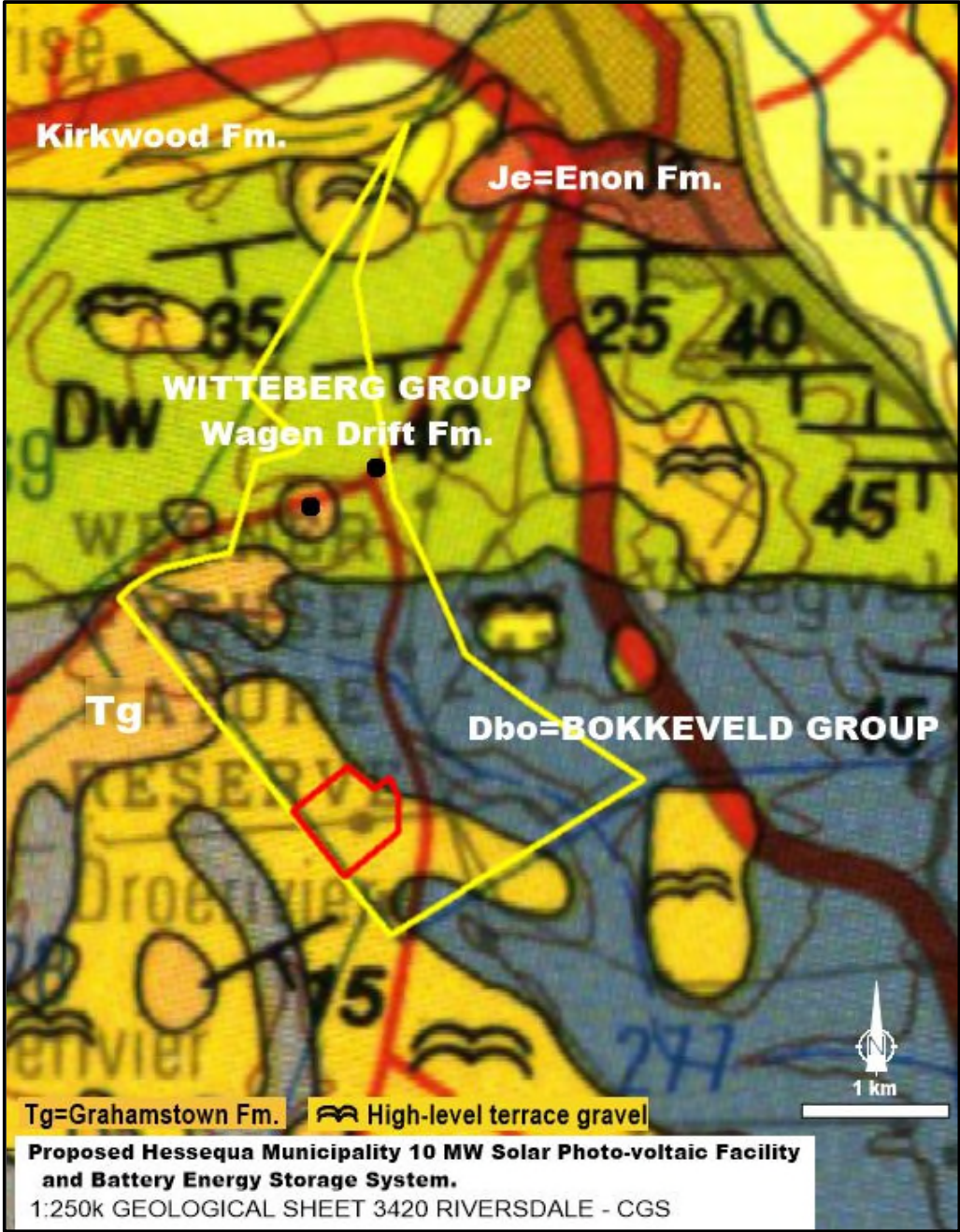
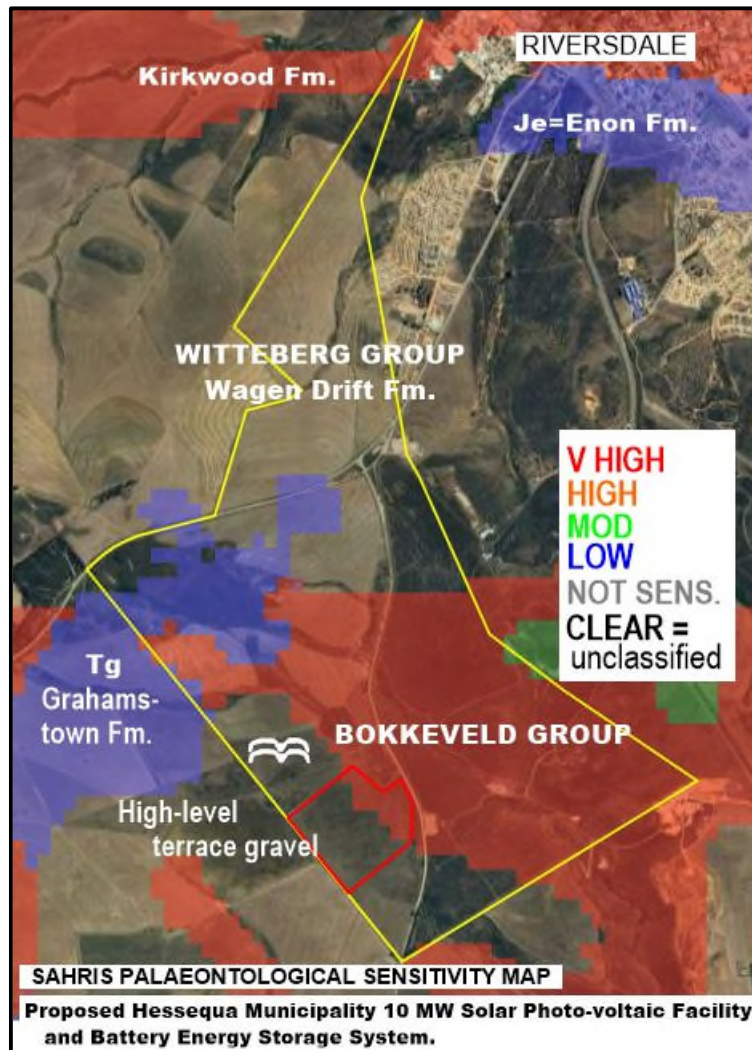


Figure 2. Geological context of Erf RE/2018.

**4 ANTICIPATED IMPACTS**

The installation of a SEF and BESS does not involve major subsurface disturbance. Typically, the main excavations are the shallow trenches for connecting cabling, while the solar panel arrays are supported on driven posts or concrete sleepers and the transformers/inverters and BESS are located on concrete slabs.



**Figure 3. Palaeontological sensitivities of formation underlying Erf RE/2018.**

The Bokkeveld Group in general is of Very High palaeontological sensitivity due to its unique fossil content (Figure 3), but in the Southern Cape coastal region it is tectonized and weathered to the extent that its constituent formations cannot be differentiated. Similarly, the fossil content of the Wagen Drift Fm. (Figure 3, unclassified, but of Moderate sensitivity), has been compromised (Figures 4, 5).



**Figure 4. The weathered (kaolinized) Wagen Drift Fm. at location 1 (Figure 1).**

The Grahamstown Fm. silcrete rocks are generally not fossiliferous, but sometimes include poorly preserved plant traces resembling reeds and very rarely burrow traces. The residual gravels on the downwasted Grahamstown Fm and the High-level terrace remnant palaeosurfaces have been subjected to a long history of pedogenesis and fossil bones are very unlikely to be preserved. It is possible that younger “superimposed” fossil bones may occur in burrows made into the gravels, such as in aardvark burrows later



appropriated by hyaenas. Nevertheless, the surficial gravels are of very LOW fossil potential and finds of fossil bones and teeth have not been reported.



**Figure 5. Thin, residual gravels overlying weathered Wagen Drift Fm. at location 2 (Figure 1).**

## **5 RECOMMENDATIONS**

In conclusion, the construction of the SEF and BESS is not anticipated to have an impact on palaeontological heritage resources.

Although the potential for fossils is very low, an occurrence cannot be entirely dismissed. The assessment of fossil potential is of a general nature and the fortuitous preservation of fossils in an otherwise unfavourable context could occur. In case of potential fossils being observed Heritage Western Cape (HWC) must then be informed and provided with information on the nature of the find:

- A description of the nature of the find.
- Detailed images of the finds (with scale included).
- Position of the find and depth.
- Digital images of the context. *i.e.* the excavation (with scales).

The HWC Fossil Finds Procedure and recording form is available from:

[https://www.hwc.org.za/sites/default/files/3\\_11%20Protocol%20Fossil%20Finds%20Final%20June%202016.pdf](https://www.hwc.org.za/sites/default/files/3_11%20Protocol%20Fossil%20Finds%20Final%20June%202016.pdf)

<https://www.hwc.org.za>. 021 483 9729 / 021 483 5959.

Heritage Western Cape will assess the information and liaise with a palaeontological specialist, as appropriate, and a suitable response will be established.

## **References**

- Penn-Clarke, C.R., Rubidge, B.S. & Jinnah, Z.A. 2018. Two hundred years of palaeontological discovery: Review of research on the Early to Middle Devonian Bokkeveld Group (Cape Supergroup) of South Africa. *Journal of African Earth Sciences* 137: 157-178.
- Thamm, A.G. & Johnson, M.R. 2006. The Cape Supergroup. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) *The Geology of South Africa*, pp. 443-459. Geological Society of South Africa, Marshalltown.

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John Pether

## 6 APPENDIX 1. DECLARATION OF INDEPENDENCE

### BRIEF PALAEOLOGICAL IMPACT ASSESSMENT

### PROPOSED SOLAR PV ENERGY FACILITY AND BATTERY ENERGY STORAGE SYSTEM

### REMAINDER OF ERF 2018, RIVERSDALE, HESSEQUA MUNICIPALITY, WESTERN CAPE

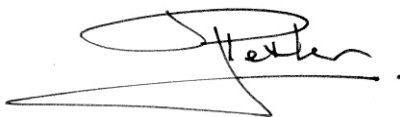
#### Terms of Reference

This assessment forms part of the Heritage Assessment and it assesses the overall palaeontological (fossil) sensitivities of formations underlying the Project Area.

#### Declaration

I ...**John Pether**....., as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in the compilation of the above report;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- have and will not have any vested interest in the proposed activity proceeding;
- have disclosed to the EAP any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management act;
- have provided the EAP with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.



Signature of the specialist

Date: 2 February 2024



## 7 APPENDIX 2. CURRICULUM VITAE

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

Independent Consultant/Researcher recognized as an authority with 38 years' experience in the field of coastal-plain and continental-shelf palaeoenvironments, fossils and stratigraphy, mainly involving the West Coast/Shelf of southern Africa. Has been previously employed in academia (South African Museum) and industry (Trans Hex, De Beers Marine). At present an important involvement is in Palaeontological Impact Assessments (PIAs) and mitigation projects in terms of the National Heritage Resources Act 25 (1999) (~350 PIA reports to date) and is an accredited member of the Association of Professional Heritage Practitioners (APHP). Continues to be involved as consultant to offshore and onshore marine diamond exploration ventures. Expertise includes:

- Coastal plain and shelf stratigraphy (interpretation of open-pit exposures, on/offshore cores and exploration drilling).
- Sedimentology and palaeoenvironmental interpretation of shallow marine, aeolian and other terrestrial surficial deposits.
- Marine macrofossil taxonomy (molluscs, barnacles, brachiopods) and biostratigraphy.
- Marine macrofossil taphonomy.
- Sedimentological and palaeontological field techniques in open-cast mines (including finding and excavation of vertebrate fossils (bones)).

### Membership of Professional Bodies

- South African Council of Natural Scientific Professions. Earth Science. Reg. No. 400094/95.
- Geological Society of South Africa.
- Palaeontological Society of Southern Africa.
- Southern African Society for Quaternary Research.
- Association of Professional Heritage Practitioners (APHP), Western Cape. Accredited Member No. 48.

### Past Clients Palaeontological Assessments

AECOM SA (Pty) Ltd.	Guillaume Nel Environmental Management Consultants.
Agency for Cultural Resource Management (ACRM).	Klomp Group.
AMATHEMBA Environmental.	Megan Anderson, Landscape Architect.
Anél Blignaut Environmental Consultants.	Ninham Shand (Pty) Ltd.
Arcus Gibb (Pty) Ltd.	PD Naidoo & Associates (Pty) Ltd.
ASHA Consulting (Pty) Ltd.	Perception Environmental Planning.
Aurecon SA (Pty) Ltd.	PHS Consulting.
BKS (Pty) Ltd. Engineering and Management.	Resource Management Services.
Bridgette O'Donoghue Heritage Consultant.	Robin Ellis, Heritage Impact Assessor.
Cape Archaeology, Dr Mary Patrick.	Savannah Environmental (Pty) Ltd.
Cape EAPrac (Cape Environmental Assessment Practitioners).	Sharples Environmental Services cc
CCA Environmental (Pty) Ltd.	Site Plan Consulting (Pty) Ltd.
Centre for Heritage & Archaeological Resource Management (CHARM).	SRK Consulting (South Africa) (Pty) Ltd.
Chand Environmental Consultants.	Strategic Environmental Focus (Pty) Ltd.
CK Rumboll & Partners.	UCT Archaeology Contracts Office (ACO).
CNdV Africa	UCT Environmental Evaluation Unit
CSIR - Environmental Management Services.	Urban Dynamics.
Digby Wells & Associates (Pty) Ltd.	Van Zyl Environmental Consultants
Enviro Logic	Western Cape Environmental Consultants (Pty) Ltd, t/a ENVIRO DINAMIK.
Environmental Resources Management SA (ERM).	Wethu Investment Group Ltd.
Greenmined Environmental	Withers Environmental Consultants.

### Stratigraphic consulting including palaeontology

Afri-Can Marine Minerals Corp	Council for Geoscience
De Beers Marine (SA) Pty Ltd.	De Beers Namaqualand Mines.
Geological Survey Namibia	IZIKO South African Museum.
Namakwa Sands (Pty) Ltd	NAMDEB

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8 APPENDIX 3. HERITAGE WESTERN CAPE RECORDING FORM

FOSSIL DISCOVERIES: HWC PRELIMINARY RECORDING FORM		
Name of project:		
Name of fossil location:		
Date of discovery:		
Description of situation in which the fossil was found:		
Description of context in which the fossil was found:		
Description and condition of fossil identified:		
GPS coordinates:	Lat:	Long:
If no co-ordinates available then please describe the location:		
Time of discovery:		
Depth of find in hole		
Photographs (tick as appropriate and indicate number of the photograph)	Digital image of vertical section (side)	
	Fossil from different angles	
	Wider context of the find	
Temporary storage (where it is located and how it is conserved)		
Person identifying the fossil	Name: Contact:	
Recorder	Name: Contact:	
Photographer	Name: Contact:	