SiVEST (PTY) LTD

PROPOSED CONSTRUCTION AND OPERATION OF THE BATTERY ENERGY STORAGE SYSTEM (BESS) AND ASSOCIATED INFRASTRUCTURE FOR THE AUTHORISED LOERIESFONTEIN 3 PV SOLAR ENERGY FACILITY LOCATED NEAR LOERIESFONTEIN IN THE HANTAM LOCAL MUNICIPALITY, NAMAKWA DISTRICT IN THE NORTHERN CAPE PROVINCE OF SOUTH AFRICA

PALAEONTOLOGICAL DESKTOP ASSESSMENT

DEA Reference: 2020-09-0029

Report Prepared by: **Elize Butler (Banzai Environmental)**

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PALAEONTOLOGICAL DESKTOP ASSESSMENT

EXECUTIVE SUMMARY

Banzai Environmental (Pty) Ltd has been appointed by SiVEST (PTY) Ltd, on behalf of South Africa Mainstream Renewable Power Loeriesfontein 3 (Pty) Ltd to undertake the assessment of the development of a Battery Energy Storage System (BESS) and associated infrastructure for the authorised Loeriesfontein 3 Solar Energy Facility (12/12/20/2321/2/AM4), located near Kimberley in the Sol Plaatje Local Municipality, Francis Baard District Municipality, in the Northern Cape Province of South Africa. The National Heritage Resources Act (No 25 of 1999, section 38) (NHRA) states that a Palaeontological Impact Assessment (PDA) is necessary to confirm if fossil material is present within the planned development. This Assessment is thus necessary to evaluate the effect of the construction on palaeontological heritage

The proposed Loeriesfontein 3 Solar BESS and associated infrastructure is primarily underlain by Karoo dolerite and Dolerite rubble with the most south westerly and northern margins of the BESS reaching the Tierberg Formation (Ecca Group, Karoo Supergroup). The most westerly end of the power line falls in the Whitehill Formation of the Ecca Group (Karoo Supergroup), while a few isolated areas of Quaternary pan sediments is also present. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Karoo dolerite and dolerite rubble is zero as it is igneous in origin while that of the Tierberg Formation is moderate. The Whitehill Formation and pan sediments also has a very high Palaeontological Sensitivity and (Almond and Pether, 2009; Almond *et al*., 2013).

Usually impacts on palaeontological heritage only occur during the construction phase of the development. As the Authorized Loeriesfontein 3 Solar BESS was originally assessed in a Palaeontological Impact Assessment and as the proposed project falls in the same area the Palaeontological Significance of the BESS and associated infrastructure is low. It is thus considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation (recording and collection) can be carry out by a paleontologist.

NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) AND ENVIRONMENTAL IMPACT REGULATIONS, 2014 (AS AMENDED) - REQUIREMENTS FOR SPECIALIST REPORTS (APPENDIX 6)

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page 7 and Appendix 2
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 8
c) an indication of the scope of, and the purpose for which, the report was prepared;	Chapter 1
(cA) an indication of the quality and age of base data used for the specialist report;	Chapter 4
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Chapter 6
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Chapter 4
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Chapter 5
g) an identification of any areas to be avoided, including buffers;	N/A
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Chapter 2

j) a description of the findings and potential implications of such findings on the impact of the proposed activity, (including identified alternatives on the environment) or activities;	Chapter 8
k) any mitigation measures for inclusion in the EMPr;	Chapter 6
l) any conditions for inclusion in the environmental authorisation;	Chapter 6
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Chapter 6
n) a reasoned opinion- i. (as to) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Chapter 8
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q) any other information requested by the competent authority.	N/A
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

PROPOSED CONSTRUCTION AND OPERATION OF THE BATTERY ENERGY STORAGE SYSTEM (BESS) AND ASSOCIATED INFRASTRUCTURE FOR THE AUTHORISED LOERIESFONTEIN 3 PV SOLAR ENERGY FACILITY LOCATED NEAR LOERIESFONTEIN IN THE HANTAM LOCAL MUNICIPALITY, NAMAKWA DISTRICT IN THE NORTHERN CAPE PROVINCE OF SOUTH AFRICA

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

SPECIALIST INFORMATION

Specialist Company Name:	Banzai Environmental (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	Leve 5	Percentage Procurement recognition	80%
Specialist name:	Elize Butler			
Specialist Qualifications:	MSc			
Professional affiliation/registration:	PSSA			
Physical address:	14 Eddie de Beer Street, Dan Pienaar, Bloemfontein			
Postal address:	14 Eddie de Beer Street, Dan Pienaar, Bloemfontein			
Postal code:	9301	Cell:	084 4478 759	
Telephone:		Fax:		
E-mail:	Elizebutler002@gmail.com			

DECLARATION BY THE SPECIALIST

I, _____ Elize Butler _____, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Banzai Environmental (Pty) Ltd

Name of Company:

Date:

UNDERTAKING UNDER OATH/ AFFIRMATION

I, _____ Elize Butler _____, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Banzai Environmental (Pty) Ltd

Name of Company

Date

Signature of the Commissioner of Oaths

Date

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List of Abbreviations

Abbreviations	Description
BESS	Battery Energy Storage System
CA	Competent Authority
DEA	Department of Environmental Affairs
DEFF	Department of Environment, Forestry and Fisheries
DIA	Desktop Impact Assessment
EO	Environmental Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
Ma	Million years ago
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PIA	Palaeontological Impact Assessment
PSSA	Palaeontological Society of South Africa
SAHRA	South African Heritage Resources Agency
ToR	Terms of Reference

SiVEST (PTY) LTD

PROPOSED CONSTRUCTION AND OPERATION OF THE BATTERY ENERGY STORAGE SYSTEM (BESS) AND ASSOCIATED INFRASTRUCTURE FOR THE AUTHORISED LOERIESFONTEIN 3 PV SOLAR ENERGY FACILITY LOCATED NEAR LOERIESFONTEIN IN THE HANTAM LOCAL MUNICIPALITY, NAMAKWA DISTRICT IN THE NORTHERN CAPE PROVINCE OF SOUTH AFRICA

PALAEONTOLOGICAL DESKTOP ASSESSMENT

1. INTRODUCTION

Banzai Environmental (Pty) Ltd has been appointed by SiVEST (PTY) Ltd, on behalf of South Africa Mainstream Renewable Power Loeriesfontein 3 (Pty) Ltd to undertake the assessment of the development of a Battery Energy Storage System (BESS) and associated infrastructure for the authorised Loeriesfontein 3 Photovoltaic (PV) Energy Facility (12/12/20/2321/2/AM4), located near Kimberley in the Sol Plaatje Local Municipality, Francis Baard District Municipality, in the Northern Cape Province of South Africa.
In terms of the Environmental Impact Assessment (EIA) Regulations, which were published on 04 December 2014 and amended on 07 April 2017 [promulgated in Government Gazette 40772 and Government Notice (GN) R326, R327, R325 and R324 on 7 April 2017], various aspects of the proposed development are considered listed activities under GNR 327 and GNR 324 which may have an impact on the environment and therefore require authorisation from the National Competent Authority (CA), namely the Department of Environment, Forestry and Fisheries (DEFF), prior to the commencement of such activities. A Palaeontological desktop assessment have been commissioned to assess and verify the BESS under the new Gazetted specialist protocols.

1.1 Scope and Objectives

The objective of a Palaeontological Impact Assessment (PIA) is to determine the impact of the development on potential palaeontological material at the site.

According to the “SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports” the aims of the PIA are: 1) to **identify** the palaeontological

status of the exposed as well as rock formations just below the surface in the development footprint 2) to estimate the **palaeontological importance** of the formations 3) to determine the **impact** on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.
The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;
- Submit a comprehensive overview of all appropriate legislation, guidelines;
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study;
- Description and location of the proposed development and provide geological and topographical maps;
- Provide Palaeontological and geological history of the affected area;
- Identification sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
    a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
    b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
    c. Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided);
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

Specific Requirements:

- Describe and map the palaeontological heritage features of the site and surrounding area. This is to be based on desk-top reviews, fieldwork, available databases, findings from other palaeontological heritage studies in the area, where relevant. Include reference to the grade of heritage feature and any heritage status the feature may have been awarded.
- Assess the impacts and provide mitigation measures to include in the environmental management plan.
- Map palaeontological heritage sensitivity for the site. Clearly show any “no-go” areas in terms of heritage (i.e. “very high” sensitivity) and provide recommended buffers or set-back distances.
- Identify and assess potential impacts from the project on palaeontology, as required by heritage legislation (including cumulative impacts from other wind farms within a radius of 50 km).
- Provide an updated sensitivity map for the Kudusberg WEF project site.
- Assess the project alternatives provided, including the no-go alternative

1.2 Terms of Reference

The terms of reference for the appointment have two elements (1) Site Verification Report and (2) a specialist study/compliance statement as per Government Notice 320 of 20 March 2020. The specialist report must include an explanation of the Terms of Reference (ToR) applicable to the specialist study. In addition, if the report is written as per Appendix 6 of the EIA Regulations, 2014 (as amended), a table must be provided at the beginning of the specialist report listing the requirements for specialist reports in accordance with and cross referencing these requirements with the relevant sections in the report. An MS Word version of this table will be provided by SiVEST.

1.3 Specialist Credentials

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-five years. She has experience in locating, collecting, and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

1.4 Assessment Methodology

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This include all trace fossils and fossils. All available information is consulted to compile a desktop study and includes: Palaeontological impact assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

2. ASSUMPTIONS AND LIMITATIONS

When conducting a Paleontological Impact Assessment (PIA) several factors can affect the accuracy of the assessment. The focal point of geological maps is the geology of the area and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is used to provide information on the existence of fossils in an area which was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **assumed** that exposed fossil heritage is present within the footprint. A field-assessment is thus necessary to improve the accuracy of the desktop assessment

3. TECHNICAL DESCRIPTION

3.1 Project Location

The BESS is located on the authorised Loeriesfontein 3 Photovoltaic (PV) Energy Facility (12/12/20/2321/2/AM4), located near Loeriesfontein in the Hantam Local Municipality, Namakwa District in the Northern Cape Province of South Africa.

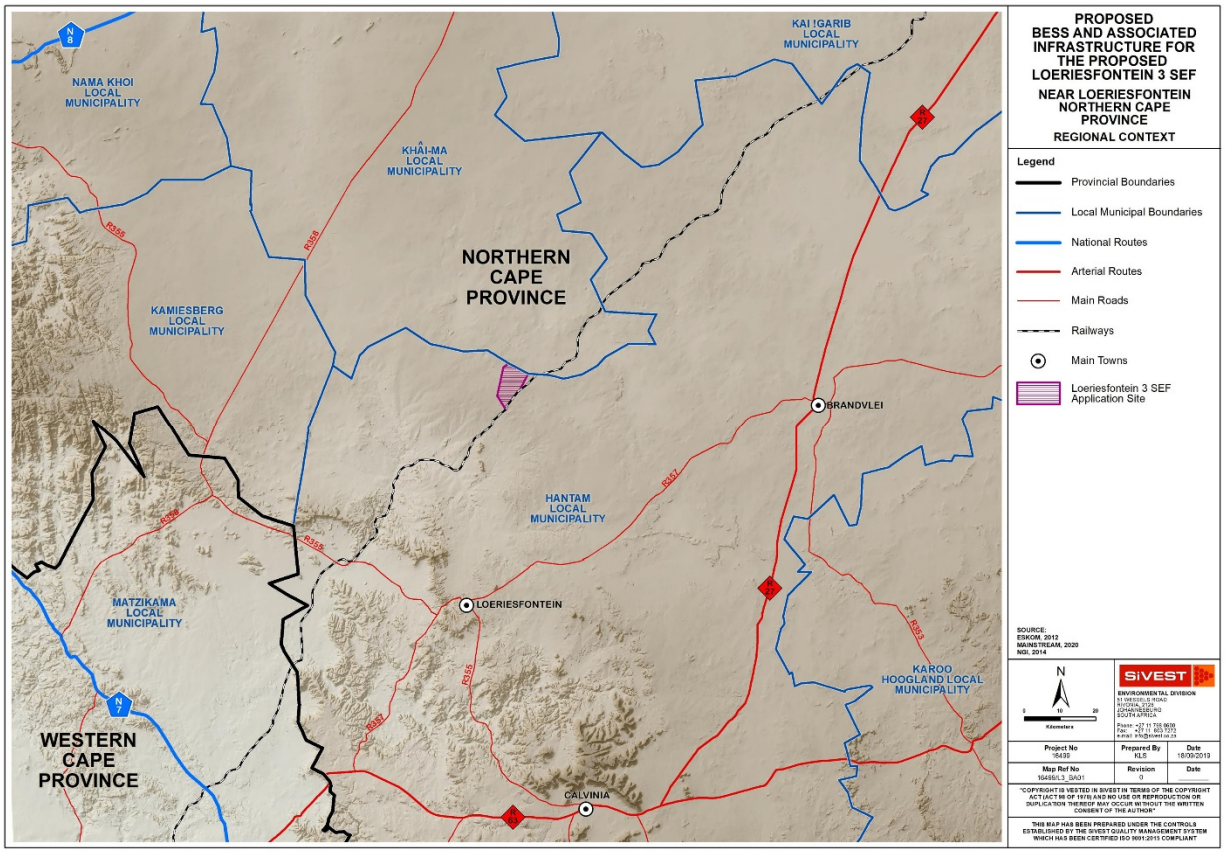

Figure 1: Regional context of the BESS located on the authorised Loeriesfontein 3 Photovoltaic (PV) Energy Facility

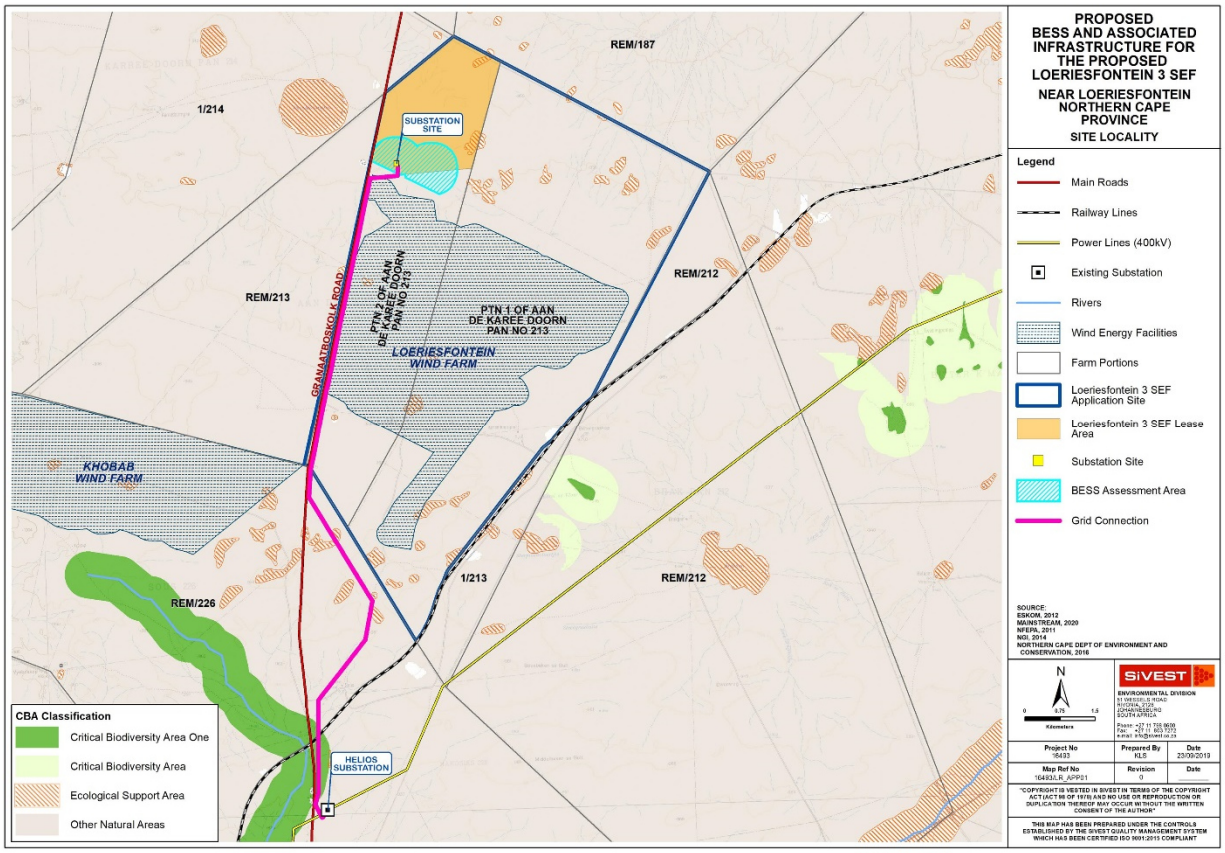

Figure 2: BESS located on the authorised Loeriesfontein 3 Photovoltaic (PV) Energy Facility

3.2 Project Description

South Africa Mainstream Renewable Power Loeriesfontein 3 (Pty) Ltd is proposing the construction and operation of Battery Energy Storage System (BESS) and associated infrastructure for the authorised Loeriesfontein 3 PV (12/12/20/2321/2/AM4). The need for a BESS stems from the fact that electricity is only produced by the Renewable Energy Facility while the sun is shining, while the peak demand may not necessarily occur during the day-time. Therefore, the storage of electricity and supply thereof during peak-demand will mean that the facility is more efficient, reliable and electricity supply more constant.

The BESS will:

- Store and Integrate a greater amount of renewable energy from the Renewable Energy Facility into the electricity grid;
- This will assist with the objective to generate electricity by means of renewable energy to feed into the National Grid which will be procured under either the Renewable Energy Independent Power Producer Procurement Program (REIPPPP), other government run procurement programmes or for sale to private entities if required

The Loeriesfontein 3 PV BESS will be located adjacent to the approved Loeriesfontein 3 PV substation associated with the approved Loeriesfontein 3. To reduce electrical losses the BESS must be in close proximity to the on-site 33/132kV substation. A ~5ha study site has been established around the approved substation (500m zone) to allow for the micrositing / specialist guidance regarding placement can be made.

3.2.1 Alternatives

No site alternatives for this proposed development were considered as the placement of the proposed BESS is dependent on the location of the Loeriesfontein 3 Photovoltaic (PV) Energy Facility (12/12/20/2321/2/AM4).

Technology alternatives are limited to battery types, namely Redox flow batteries and Solid State Batteries. No other activity alternatives are being considered.

Table 1:The BESS alternatives:

BESS Specifications	
BESS Footprint	Up to 2Ha
BESS Capacity	200MWh
BESS Technology	Lithium Ion
BESS Type Alternative- Solid State Batteries	Containerised systems assembled within shipping containers and delivered to the project site. Dimensions are approximately 17 m long x 3.5 m wide x 4 m high. Containers will be placed on a raised concrete plinth (30 cm) and may be stacked on top of each other to a maximum height of approximately 15 m. Additional instrumentation, including inverters and temperature control equipment, may be positioned between the battery containers.

The 'no-go' alternative is the option of not constructing and operating a BESS in support of the authorised Renewable Energy (RE) facility. This alternative would result in no additional environmental impact other than that assessed during the EIA for the RE facility

The 'no-go' option is an option; however, this would prevent the Loeriesfontein 3 PV Facility from contributing to the environmental, social and economic benefits associated with the development of the renewables sector.

The above-mentioned alternatives (including 'no-go' alternative) will all be assessed by the appointed specialists as part of the BA process. All the above-mentioned location alternatives will be informed by the identified environmental sensitive and/or 'no-go' areas (i.e. status quo). The respective alternatives being considered as part of the BA process for the proposed development will also be comparatively assessed.

4. LEGAL REQUIREMENT AND GUIDELINES

National Heritage Resources Act (25 of 1999)

Cultural Heritage includes all heritage resources and is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act comprise **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**".

Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
- the construction of a bridge or similar structure exceeding 50 m in length;
- any development or other activity which will change the character of a site—
- (exceeding 5 000 m^2 in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m² in extent;
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

5. DESCRIPTION OF THE RECEIVING ENVIRONMENT

The proposed Loeriesfontein 3 PV BESS and associated infrastructure is depicted on the 1:250 000 3018 Loeriesfontein Geological Map (2010) (Council of Geosciences, Pretoria). The proposed development is primarily underlain by Karoo dolerite (Jd) and Dolerite rubble (Qg_1) with the most south westerly and northern margins of the BESS touching the Tierberg Formation (Pt)) (Ecca Group, Karoo Supergroup). The most westerly end of the power line falls in the Whitehill Formation (Pw) of the Ecca Group (Karoo Supergroup) Figure 3). Small areas of pan sediments Q-p are also present in the development. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Karoo dolerite and dolerite rubble is zero as it is igneous in origin while that of the Tierberg

Formation is moderate. The Whitehill Formation and Pan Sediments has a very high Palaeontological Sensitivity and (Almond and Pether, 2009; Almond *et al*., 2013).

The quaternary sediments contain fossils that represent terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods and trace fossils. The palaeontology of the Quaternary superficial deposits has been relatively neglected in the past. Late Cenozoic calcrete may comprise of bones, horn corns as well as mammalian teeth (Klein, 1984). Tortoise remains have also been uncovered as well as trace fossils which includes termite and insect's burrows and mammalian trackways. Amphibian and crocodile skeletons have been uncovered where the depositional settings in the past were wetter.

The Gordonia dune sands are dated as Late Pliocene/Early Pleistocene to Recent times by the Middle to Later Stone Age stone tools recovered from them (Dingle *et al.,* (1983). The boundary of the Pliocene-Pleistocene has been extended back from 1.8 Ma to 2.588 Ma placing the Gordonia Formation almost entirely within the Pleistocene Epoch. The pan sediments of the area originated from the Gordonia Formation and contains white to brown fine-grained silts, sands and clays. Some of the pans consist of clayey material mixed with evaporates that shows seasonal effects of shallow saline groundwaters (De Witt et al., 2000; Johnsen *et al*, 2006).

Dolerite rubble (Qg_1) covers almost all the sediment in the area. The dolerite present in the development belongs to the Karoo Igneous Province that is a classic continental flood basalt province formed during the Early Jurassic. This province occurs over a large area in southern Africa and comprises a widespread system well developed igneous bodies (dykes, sills) that invaded the sediments of the Main Karoo Basin. Flood basalts do not typically form any visible volcanic structures, but with a series of outbursts form a suite of fissures of sub-horizontal lava flows that may vary in thickness. The Karoo is an old flood basalt province and is preserved today as erosional remnants of a more extensive lava cap that covered much of southern Africa in the geological past. As this Suite consist of igneous rocks it is unfossiliferous. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Karoo Dolerite is zero.

The majority of the Tierberg Formation comprises of well-laminated, dark grey to black shale (Johnson et al 2006). Some yellowish tuffaceous beds up to 10cm thick occur in the lower part of the succession along the western and northern margins of the Basin. Calcareous concretions are common towards the top of the formation. Clastic rhythmites occur at various levels in the sequence (Cole, 2005). This formation is considered to be a deep-water deposit associated with event beds. The Tierberg formation is known for its rare trace fossils assemblages. Vascular plants (including petrified wood) and palynomorphs of Glossopteris flora have been found while crustaceans, shelly marine invertebrates, insects and fish fossils as well as microfossils have been identified.

The Whitehill Formation of the Ecca Group is a comparatively thin succession of well-laminated carbon-rich mudrocks. The mudstone weathers to a characteristic pale grey to creamy white color (Johnson et al, 2006). The Permian aged Whitehill Formation (high Palaeontological Sensitivity) is renowned for an abundance of body fossils as well as trace fossils. Almond (2011) described the main groups of Early Permian fossils found within the Whitehill Formation include as follows:

• A low diversity of trace fossils (possible shark coprolites / faeces and king crab trackways)

• Several palaeoniscoid fish species (primitive bony fish)

• Aquatic mesosaurid reptiles (the earliest known sea-going reptiles)

• Small eocarid crustaceans are very common (bottom-living shrimp-like forms)

• Insects (preserved as isolated wings, although some intact specimens has also been recovered)

• Other rare vascular plant remains (*Glossopteris* leaves, lycopods *etc*)".

• Palynomorphs (organic-walled spores and pollens)

• Petrified wood (mostly of primitive gymnosperms, silicified or calcified)

• Occasional cephalochordates (ancient relatives of the living lancets)

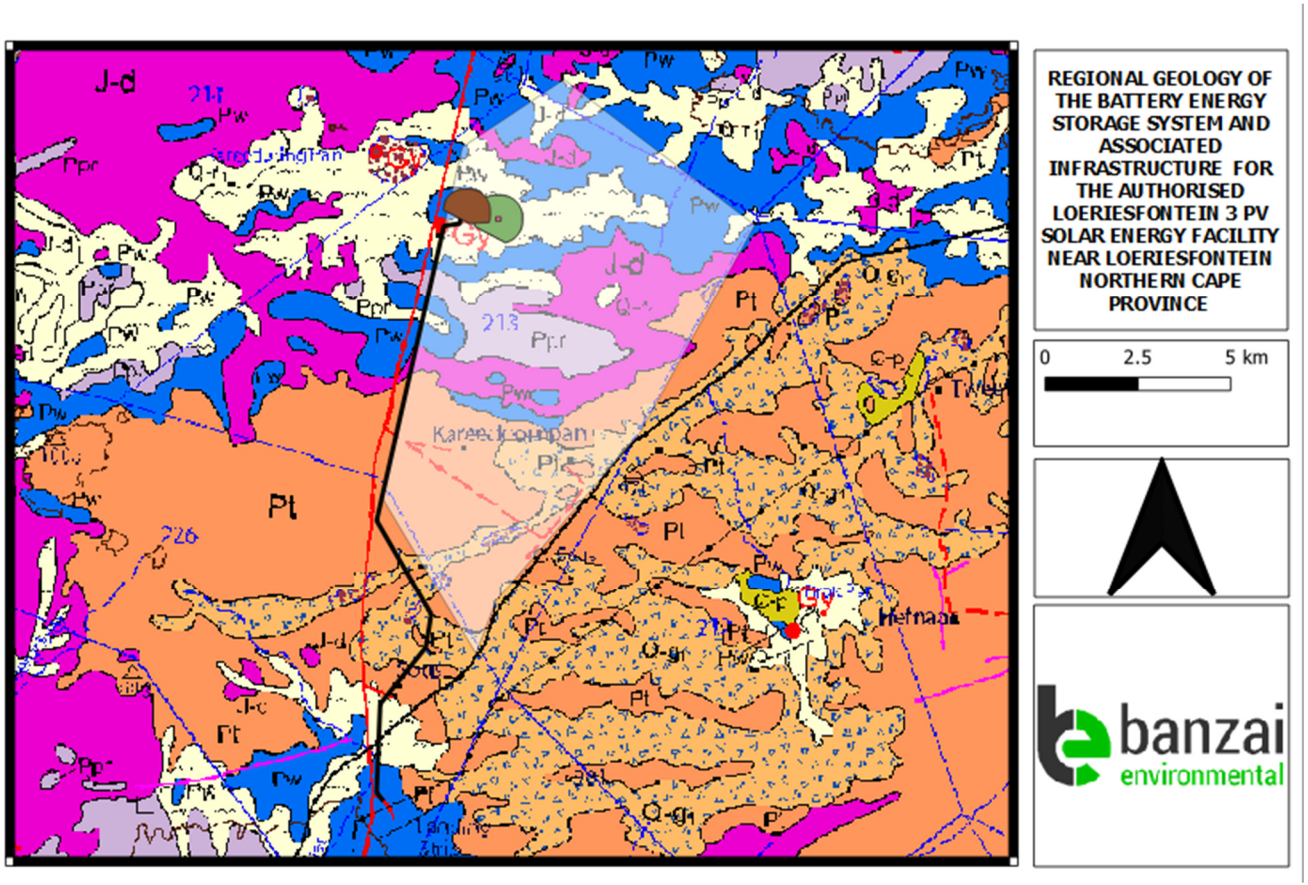

Figure 3. Surface geology of the proposed Battery Energy System and associated infrastructure for the authorized Loeriesfontein 3 PV. The proposed BESS is indicated by green and brown blue while the associated grid infrastructure is indicated black. Map was drawn by QGIS 2.18

Legend and short description

Q-p- quaternary pan sediments

Jd- Karoo Dolerite

Qg_{1}- Dolerite rubble

Pt- Tierberg Formation; Ecca Group, Karoo Supergroup

Pw- Whitehill Formation (Pw) of the Ecca Group (Karoo Supergroup)

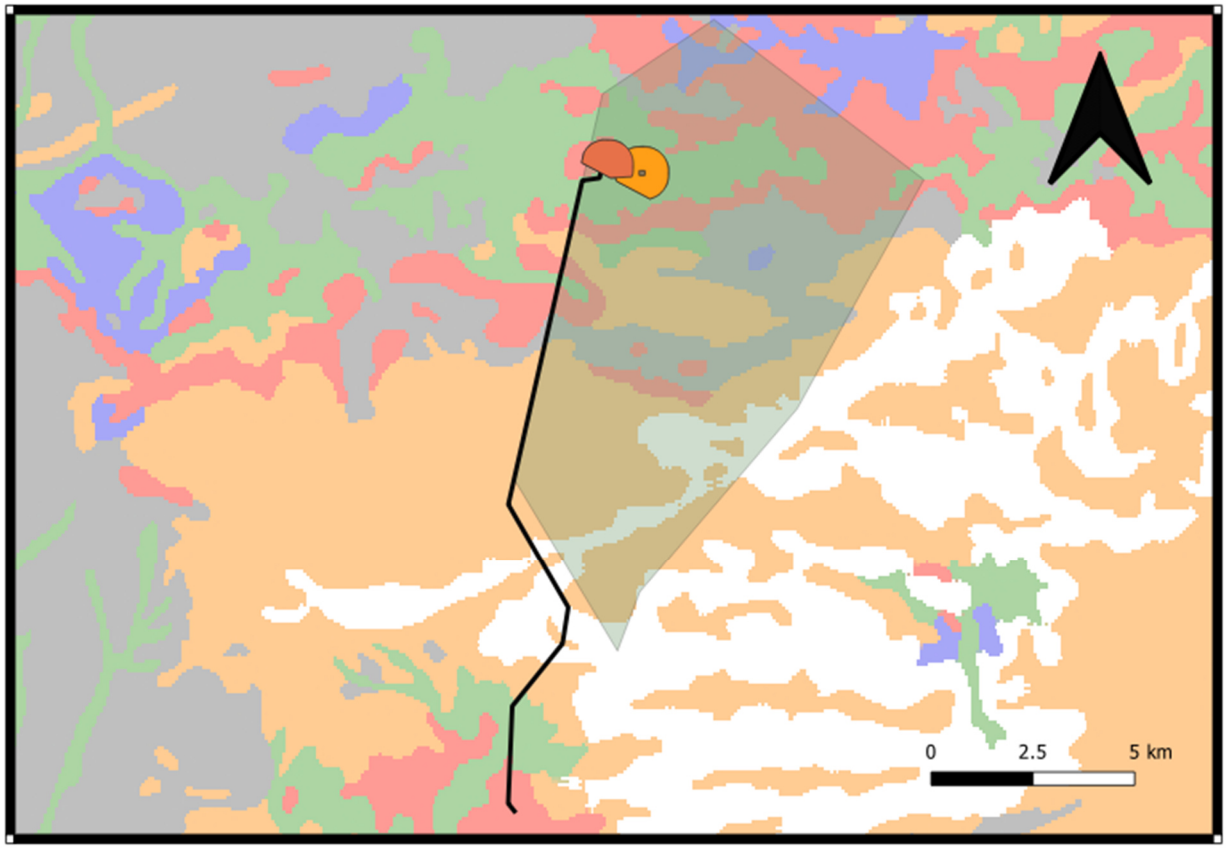

Figure 4: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences).

Location of the proposed BESS and the associated infrastructure is underlain by red (very high), orange (High) green (moderate) areas. According to this map there is a very high chance of finding fossils in the red area, high chance in the orange area and amoderate chance of finding fossils in the green area of the development footprint and a low chance in the blue areas.

Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required

ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	**MODERATE**	**desktop study is required**
BLUE	**LOW**	**no palaeontological studies are required however a protocol for finds is required**
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

However, according to the National Environmental Screening tool (https://screening.environment.gov.za/screeningtool Accessed 6 November 2020) the sensitivity of the Loeriesfontein 3 BESS and associated infrastructure is high (Figure 5).

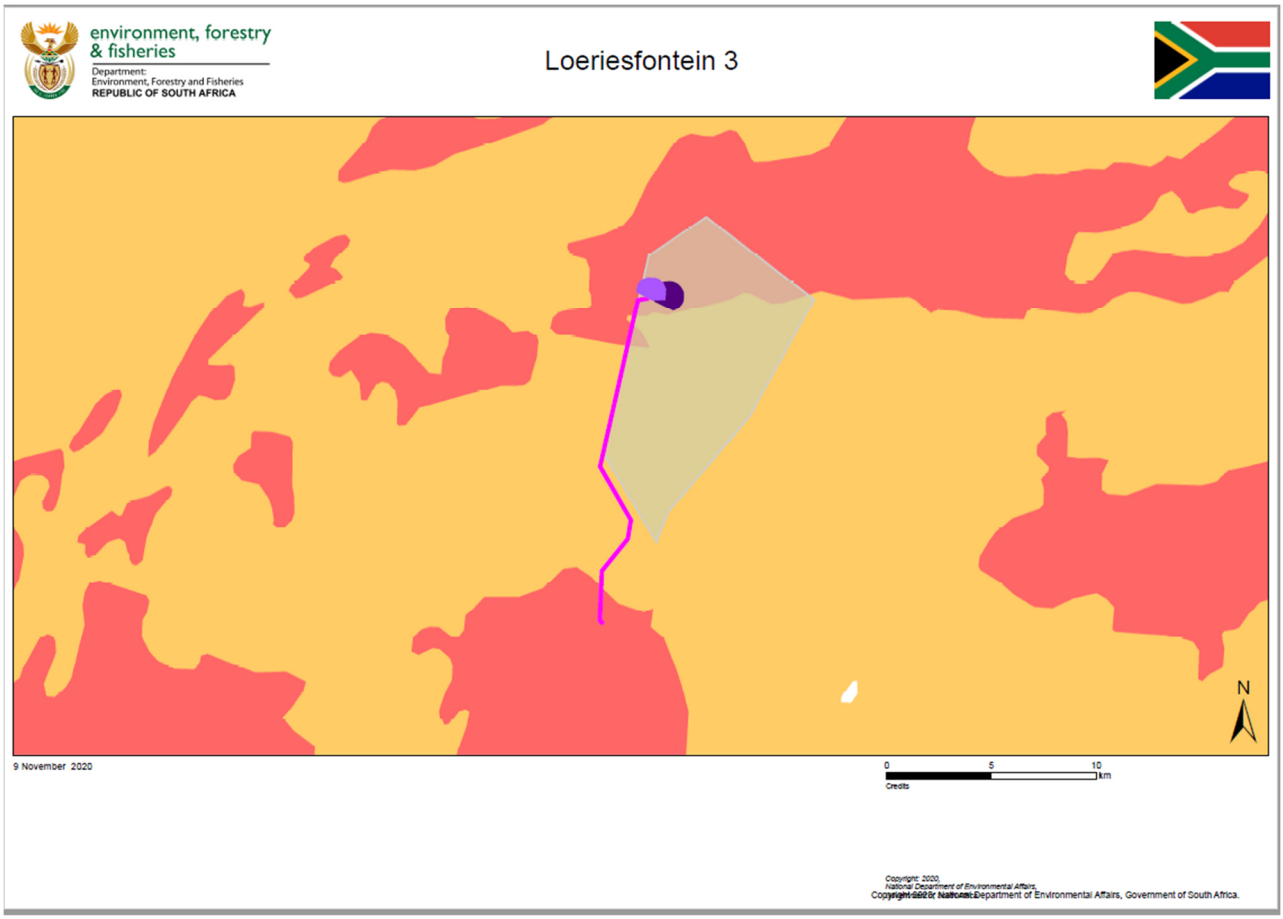

Figure 5: Environmental Screening tool indicates that the Palaeontological Sensitivity of the proposed Loeriesfontein 3 BESS and associated infrastructure is high(red).

6. SPECIALIST FINDINGS / IDENTIFICATION AND ASSESSMENT OF IMPACTS

The proposed Loeriesfontein 3 Solar BESS and associated infrastructure is primarily underlain by Karoo dolerite and Dolerite rubble with the most south westerly and northern margins of the BESS touching the Tierberg Formation (Ecca Group, Karoo Supergroup). The most westerly end of the power line falls in the Whitehill Formation of the Ecca Group (Karoo Supergroup). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Karoo dolerite and dolerite rubble is zero as it is igneous in origin while that of the Tierberg Formation is moderate. The Whitehill Formation and pan sediments have a very high Palaeontological Sensitivity (Almond and Pether, 2009; Almond *et al*., 2013).

Usually impacts on palaeontological heritage only occur during the construction phase of the development. As the Authorized Loeriesfontein 3 Solar BESS was originally assessed in a Palaeontological Impact Assessment and as the proposed project falls in the same area the Palaeontological Significance of the BESS and associated infrastructure is low. It is thus considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation (recording and collection) can be carry out by a paleontologist.

6.1 CHANCE FINDS PROTOCOL

A following procedure will only be followed if fossils are uncovered during excavation.

6.1.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 25 of 1999) (NHRA).** According to Section 3 of the Act, all Heritage resources include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**".

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens

of South Africa. Palaeontological resources may not be excavated, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

6.1.2 Background

A fossil is the naturally preserved remains (or traces) of plants or animals embedded in rock. These plants and animals lived in the geologic past millions of years ago. Fossils are extremely rare and irreplaceable. By studying fossils, it is possible to determine the environmental conditions that existed in a specific geographical area millions of years ago.

6.1.3 Introduction

This informational document is intended for workmen and foremen on construction sites. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

It is the responsibility of the Environmental Site Officer (ESO) or site manager of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the absence of the ESO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

6.1.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.

- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO (site manager). Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

6.2 Planning / Pre construction

No Impacts will occur during the Planning, Pre-Construction, Operational and Decommissioning Phases.

6.3 Construction

Only the Construction phase will be affected

6.4 No go Impact

The 'no-go' alternative is the option of not constructing and operating a BESS in support of the authorised Renewable Energy (RE) facility. This alternative would result in no additional environmental impact other than that assessed during the EIA for the RE facility

6.5 Cumulative Impacts

A total of 12 Renewable Energy Facilities (approved and existing) is present in a 35 km radius of the Loeriesfontein 3 SEF (Figure 6) (8 projects are WEFs and 4 SEFs).

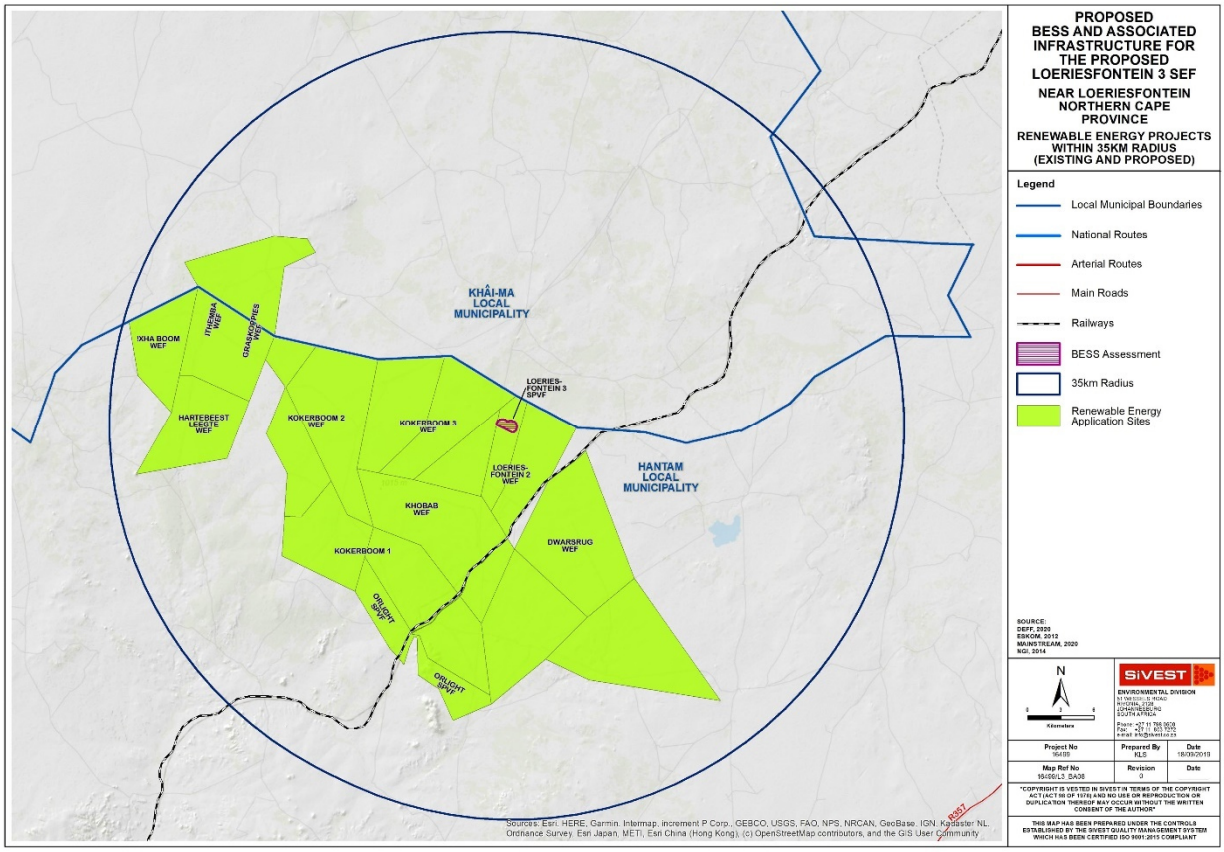

Figure 6:Renewable Energy Projects within a 35 km radius from the development

6.6 Overall Impact Rating

The significance of the impact occurring will be negative medium high before mitigation and negative low after mitigation. Post mitigation the overall significance will be low as the superficial sediments has h low sensitivity but locally high. Excavations into bedrock will also not be deep and thus the overall significance of the development will be low

Table 2: Rating of impacts template and example

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Loss of fossil heritage	Loss of fossil heritage.	2	4	4	4	4	3	54	-	Medium	**Protocol for Finds These measures will be detailed in the EMPr.**	2	4	4	4	4	1	18	-	Low
Cumulative Loss of fossil heritage	Destroy or permanently seal-in fossils at or under the ground surface that are then not available for scientific study	2	4	4	4	4	3	54	-	Medium	N/A	2	4	4	4	4	1	18	-	Low

6.7 Impact Summary

Loss of fossil heritage will have a negative impact. Only the affected properties (localities) will be affected by the proposed development. The expected duration of the impact is assessed as potentially permanent. In the absence of mitigation procedures, the damage or destruction of any palaeontological materials will be permanent. Impacts on palaeontological heritage during the construction phase could potentially occur and are regarded as having a high probability. The significance of the impact occurring will be medium before mitigation and Low after mitigation.

7. COMPARATIVE ASSESSMENT OF ALTERNATIVES

No site alternatives for this proposed development were considered as the placement of the proposed BESS is dependent on the location of the Loeriesfontein 3 (PV) Energy Facility (12/12/20/2321/2/AM4). by SiVEST.

7.1 No-Go Alternative

Consideration must be given to the 'no-go' option in the BA process. The "no-go" option assumes that the site remains in its current state, i.e. there is no construction of a Solar PV and associated infrastructure in the proposed project area and the status quo would proceed.

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8. CONCLUSION and Summary

8.1 Summary of Findings

The proposed Loeriesfontein 3 Solar BESS and associated infrastructure is primarily underlain by Karoo dolerite and Dolerite rubble with the most south westerly and northern margins of the BESS touching the Tierberg Formation (Ecca Group, Karoo Supergroup). The most westerly end of the power line falls in the Whitehill Formation of the Ecca Group (Karoo Supergroup). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Karoo dolerite and dolerite rubble is zero as it is igneous in origin while that of the Tierberg Formation is moderate. The Whitehill Formation and pan sediments have a very high Palaeontological Sensitivity (Almond and Pether, 2009; Almond *et al*., 2013).

Usually impacts on palaeontological heritage only occur during the construction phase of the development. As the Authorized Loeriesfontein 3 Solar BESS was originally assessed in a Palaeontological Impact Assessment and as the proposed project falls in the same area the Palaeontological Significance of the BESS and associated infrastructure is low. It is thus considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape

Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation (recording and collection) can be carry out by a paleontologist.

8.2 Conclusion

8.3 Impact Statement

The significance of the impact occurring will be medium before mitigation and Low after mitigation.
The overall impact of the Loeriesfontein BESS and associated grid connections, on the paleontological resources, is seen as acceptably low after the recommendations have been implemented and therefore, impacts can be mitigated to acceptable levels allowing for the development to be authorised.

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APPENDIX 1
IMPACT METHODOLOGY

Environmental impact assessment (EIA) methodology

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global), whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

Planning;
Construction;
Operation; and
Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

The significance of Cumulative Impacts should also be rated (As per the Excel Spreadsheet Template).

Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 3: Rating of impacts criteria

ENVIRONMENTAL PARAMETER		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		

1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		

Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE (S)

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.

24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

The table below is to be represented in the Impact Assessment section of the report. The excel spreadsheet template can be used to complete the Impact Assessment.

Rating of impacts template and example

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Vegetation and protected plant species	Vegetation clearing for access roads, turbines and their service areas and other infrastructure will impact on vegetation and protected plant species.	2	4	2	2	3	3	39	-	Medium	**Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.**	2	4	2	1	3	2	24	-	Low

APPENDIX 2

CURRICULUM VITAE
ELIZE BUTLER

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	26 years in Palaeontology

EDUCATION:

B.Sc Botany and Zoology, 1988
University of the Orange Free State

B.Sc (Hons) Zoology, 1991
University of the Orange Free State

Management Course, 1991
University of the Orange Free State

M. Sc. *Cum laude* (Zoology), 2009
University of the Free State

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

MEMBERSHIP

Palaeontological Society of South Africa (PSSA)	2006-currently

EMPLOYMENT HISTORY

Part time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part time laboratory assistant	Department of Virology University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

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