PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED THE ALETTA WIND ENERGY FACILITY (WEF) WILL BE LOCATED APPROXIMATELY 17KM EAST OF COPPERTON AND THE ALTERNATIVE EUREKA WIND ENERGY FACILITY (WEF) WILL BE LOCATED APPROXIMATELY 5KM NORTH-EAST OF COPPERTON, WITH ASSOCIATED CORRIDORS FOR POWER LINES, WITHIN THE SIYATHEMBA LOCAL MUNICIPALITY OF THE PIXLEY KA SEME DISTRICT MUNICIPALITY IN THE NORTHERN CAPE PROVINCE.

(Revised version February 2017: SAHRA Case No 9810)

For:

## **HIA CONSULTANTS**

# PGS

DATE: 17 February 2017

By

Gideon Groenewald 078 713 6377

#### **EXECUTIVE SUMMARY**

Gideon Groenewald was appointed by PGS Heritage to undertake a Desktop Survey, assessing the potential Palaeontological Impact of the Aletta Wind Energy Facility (WEF) will be located approximately 17km east of Copperton and the alternative Eureka Wind Energy Facility (WEF) will be located approximately 5km north-east of Copperton, with associated corridors for Power Lines, within the Siyathemba Local Municipality of The Pixley Ka Seme District Municipality in The Northern Cape Province.

This report forms part of the Environmental Impact Assessment and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Heritage Impact Assessment (HIA) is required to assess any potential impacts to palaeontological heritage within the development footprint of the development. The two alternative Layout sites Aletta and Eureka as well as the power line corridors are all allocated a Moderate Palaeontological Sensitivity and are therefore described in one Desktop Survey which is this report.

The Aletta Wind Energy Facility (WEF) will be located approximately 17km east of Copperton and the alternative Eureka Wind Energy Facility (WEF) will be located approximately 5km north-east of Copperton, with associated corridors for Power Lines, within the Siyathemba Local Municipality of The Pixley Ka Seme District Municipality in The Northern Cape Province.

The study area is underlain by presumably Mokolian aged Uitdraai Formation of the Brulpan Group Olifantshoek Supergroup, Carboniferous to Permian aged Dwyka Group, Karoo Supergroup and Quaternary aged Gordonia Formation of the Kalahari Group.

The allocation of a Moderate sensitivity for Palaeontological Heritage to the entire study area indicates that the EAP must be aware of the possibility that significant fossils might be exposed during the initial construction activities and a "Chance Find Protocol" document should form part of the EMPr od this development to ensure that significant new fossil finds are recorded properly.

Although the Uitdraai Formation can provide new information on micro-fossils of Mokolian age, these fossils are very difficult to identify and are more of academic interest. Both the Dwyka Group and Gordonia Formations are however known for some very significant fossil finds and although scarce, the fossils can contribute significantly to our understanding of depositional environments during the Carboniferous, Permain and Quaternary ages in South Africa. It is recommended that the EAP and the ECO be informed of these fossils assemblages known from these groups of rocks and to be aware of the possible presence of the fossils during exposure of rock during the construction phase of this project.

#### **Recommendations:**

1. The EAP as well as the ECO for this project must be made aware of the fact that sediments of the Uitdraai Formation, Bulpan Group, can contain significant micro-fossil remains, albeit mostly algal structures. The shale of the Dwyka Group can contain significant fossils and it is advisable that a Palaeontologist be appointed at the start of the construction in areas underlain by this group, to visit the site initially to ensure that no significant fossils are damaged. The Gordonia Formation is mainly windblown sand but if the EAP, ECO and/or HIA specialist observe any suspiciously looking structures during excavation into these rock types, the Palaeontologist must be informed and at least one site visit is recommended to ensure that no fossils are damaged. 2. All groundwater related issues must be addressed by the groundwater consultants to the project, following the prescriptions contained in the National Water Act (Act no 36 of 1998).

3. The recommendations must be included in the EMPr of the project.

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## 1. INTRODUCTION

## 1.1. Background

Gideon Groenewald was appointed by PGS Heritage to undertake a Desktop Survey, assessing the potential Palaeontological Impact of the Aletta Wind Energy Facility (WEF) will be located approximately 17km east of Copperton and the alternative Eureka Wind Energy Facility (WEF) will be located approximately 5km north-east of Copperton, with associated corridors for Power Lines, within the Siyathemba Local Municipality of The Pixley Ka Seme District Municipality in The Northern Cape Province.

This report forms part of the Environmental Impact Assessment and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Heritage Impact Assessment (HIA) is required to assess any potential impacts to palaeontological heritage within the development footprint of the development. The two alternative Layout sites Aletta and Eureka as well as the power line corridors are all allocated a Moderate Palaeontological Sensitivity and are therefore described in one Desktop Survey which is this report. Geological structures associated with groundwater need to be addressed by groundwater consultants and will not form part of this Palaeontological Impact Assessment.

Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

#### 1.2. Aims and Methodology

Following the *"SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports"* the aims of the palaeontological impact assessment are:

- to identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

In preparing a palaeontological desktop study the potential fossiliferous rock units (groups, formations etc.) represented within the study area are determined from geological maps (2922 Prieska and 2924 Koffiefontein). The known fossil heritage within each rock unit is inventoried from the published scientific literature and previous palaeontological impact studies in the same region. All mapped historic spring sites and potential groundwater zones are not included in the PIA Study.

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1.1 below.

## Table 1-1 Palaeontological Sensitivity Analysis Outcome Classification

PALAEONTOLOGICAL SIGNIFICANCE/VULNERABILITY OF ROCK UNITS					
The following colour scheme is proposed for the indication of palaeontological sensitivity classes. This classification of sensitivity is adapted from that of Almond et al (2008) and Groenewald et al., (2014)					
RED	Very High Palaeontological sensitivity/vulnerability. Development will most likely have a very significant impact on the Palaeontological Heritage of the region. Very high possibility that significant fossil assemblages will be present in all outcrops of the unit. Appointment of professional palaeontologist, desktop survey, phase I Palaeontological Impact Assessment (PIA) (field survey and recording of fossils) and phase II PIA (rescue of fossils during construction ) as well as application for collection and destruction permit compulsory.				
ORANGE	High Palaeontological sensitivity/vulnerability. High possibility that significant fossil assemblages will be present in most of the outcrop areas of the unit. Fossils most likely to occur in associated sediments or underlying units, for example in the areas underlain by Transvaal Supergroup dolomite where Cenozoic cave deposits are likely to occur. Appointment of professional palaeontologist, desktop survey and phase I Palaeontological Impact Assessment (field survey and collection of fossils) compulsory. Early application for collection permit recommended. Highly likely that a Phase II PIA will be applicable during the construction phase of projects.				
GREEN	Moderate Palaeontological sensitivity/vulnerability. High possibility that fossils will be present in the outcrop areas of the unit or in associated sediments that underlie the unit. For example areas underlain by the Gordonia Formation or undifferentiated soils and alluvium. Fossils described in the literature are visible with the naked eye and development can have a significant impact on the Palaeontological Heritage of the area. Recording of fossils will contribute significantly to the present knowledge of the development of life in the geological record of the region. Appointment of a professional palaeontologist, desktop survey and phase I PIA (ground proofing of desktop survey) recommended.				
BLUE	Low Palaeontological sensitivity/vulnerability. Low possibility that fossils that are described in the literature will be visible to the naked eye or be recognized as fossils by untrained persons. Fossils of for example small domal Stromatolites as well as micro-bacteria are associated with these rock units. Fossils of micro-bacteria are extremely important for our understanding of the development of Life, but are only visible under large magnification. Recording of the fossils will contribute significantly to the present knowledge and understanding of the development of Life in the region. Where geological units are allocated a blue colour of significance, and the geological unit is surrounded by highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a blue colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in dolerite sill outcrops. Collection of a representative sample of potential fossiliferous material recommended. At least a Desktop Survey is recommended and a "Chance Find protocol" must be compiled with or without a Phase 1 field assessment.				

Very Low Palaeontological sensitivity/vulnerability. Very low possibility that significant fossils will be present in the bedrock of these geological units. The rock units are associated with intrusive igneous activities and no life would have been possible during implacement of the rocks. It is however essential to note that the geological units mapped out on the geological maps are invariably overlain by Cenozoic aged sediments that might contain significant fossil assemblages and archaeological material. Examples of significant finds occur in areas underlain by granite, just to the west of Hoedspruit in the Limpopo Province, where significant assemblages of fossils and clay-pot fragments are associated with large termite mounds. Where geological units are allocated a grey colour of significance, and the geological GREY unit is surrounded by very high and highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a grey colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in dolerite sill outcrops. It is important that the report should also refer to archaeological reports and possible descriptions of palaeontological finds in Cenozoic aged surface deposits. At least a Desktop Survey is recommended and a "Chance Find protocol" must be compiled with or without a Phase 1 field assessment.

## 1.3. Scope and Limitations of the Desktop Study

The study will include: i) an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units; ii) a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports; iii) data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged) and iv) where feasible, location and examination of any fossil collections from the study area (e.g. museums).

The key assumption for this scoping study is that the existing geological maps and datasets used to assess site sensitivity are correct and reliable. However, the geological maps used were not intended for fine scale planning work and are largely based on aerial photographs alone, without ground-truthing. There is also an inadequate database for fossil heritage for much of the RSA, due to the small number of professional palaeontologists carrying out fieldwork in RSA. Most development study areas have never been surveyed by a palaeontologist.

These factors may have a major influence on the assessment of the fossil heritage significance of a given development and without supporting field assessments may lead to either:

- an underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
- an overestimation of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium etc.).

## 2. DESCRIPTION OF THE PROPOSED DEVELOPMENTS

#### 2.1. Aletta Wind Energy Facility

The proposed Aletta Wind Energy Facility (WEF) will be located approximately 17km east of Copperton, within the Siyathemba Local Municipality of the Pixley ka Seme District Municipality in the Northern Cape Province. The proposed project is located on the following properties:

- Portion 1 of Drielings Pan No.101
- Portion 2 of Drielings Pan No.101
- Portion 3 of Drielings Pan No.101
- Remainder of Drielings Pan No.101

#### 2.1.1. Wind Farm Technical details

The key technical details and infrastructure required is presented in the table below (**Error! Reference source not found.**).

Project	DEA Reference	Farm name and area		Te	chnical details and infrastructure		
Name		Ιa	r ann name and area			ne	cessary for the proposed project
Aletta	14/12/16/3/3/2/945	•	Portion	1	of	-	60 wind turbines with a total export
WEF			Drielings		Pan		capacity of up to 140MW. Turbines will
			No.101				have a hub height of up to 120m and a
		•	Portion	2	of		rotor diameter of up to 150m.
			Drielings		Pan	•	132kV onsite Aletta IPP Substation
			No.101			•	The turbines will be connected via
		•	Portion	3	of		medium voltage cables to the
			Drielings		Pan		proposed 132kV onsite Aletta IPP
			No.101				Substation.
		•	Remainde	er of		•	Internal access roads are proposed to
			Drielings	Pan			be between 4m to 6m wide.
			No.101			•	A temporary construction lay down
							area.
						•	A hard standing area / platform per
							turbine.
						•	The operations and maintenance
							buildings, including an on-site spares
							storage building, a workshop and an
							operations building.
						•	Fencing (if required) will be up to 5m
							where required and will be either mesh
							or palisade.

#### Table 2-1 Project Details Aletta Wind Energy Facility

## 2.1.2. Substation and Power Line Technical details

The overall objective of the project is to feed the electricity generated at the proposed Aletta Wind Energy Facility (WEF) into the National Grid.

The proposed project consists of the following main activities:

- Construction of 1 x 132kV substation (referred to as the "proposed Aletta substation")
- Construction of 1 x 132kV power line from the proposed Aletta substation to one of the following potential connection points:
  - Kronos Main Transmission Substation;
  - Cuprum Substation;
  - Proposed Copperton Wind Substation; or
  - Cuprum Hydra 1 132kV Power Line (Loop in loop out).
- •

The proposed power line will consist of a series of towers located approximately 200m to 250m apart. The type of power line towers which are being considered at this stage include self-supporting suspension monopole structures where the line is relatively straight and angle strain towers where the line deviates from zero degree with a large angle. The steel monopole tower type is between 18 and 25m in height. The height will vary based on the terrain, but will ensure minimum overhead line clearances with buildings and surrounding infrastructure. The exact location of the towers will be determined during the final design stages of the power line.

A power line corridor of approximately 500m wide is being proposed to allow flexibility when determining the final route alignment, however only a 31m wide servitude would be required for the proposed 132kV power line. As such, the 31m wide servitude would be positioned within the corridor.

Two alternative sites for the proposed Aletta substation will be assessed during the Basic Assessment. The size of the substation site will be approximately 150m x 150m.

#### 2.1.3. Project Location

The proposed Aletta substation and 132kV power will be located to the south-east of Copperton, within the Siyathemba Local Municipality of the Pixley ka Seme District Municipality in the Northern Cape Province.

## 2.2. Eureka Wind Energy Facility

#### 2.2.4. Project Location

The proposed Eureka Wind Energy Facility (WEF) will be located approximately 5km north-east of Copperton, within the Siyathemba Local Municipality of the Pixley ka Seme District Municipality in the Northern Cape Province. The proposed project is located on the following properties:

- Portion 8 of Nelspoortje No. 103
- Portion 9 of Nelspoortje No. 103
- Portion 3 of Blaauwbosch Poortje No. 66
- Remainder of Blaauwbosch Poortje No. 66

#### 2.2.5. Wind Farm Technical details

The key technical details and infrastructure required is presented in the table below (**Error! Reference source not found.**).

Project	DEA	Form nome and area	Technical details and infrastructure
Name	Reference	Farm name and area	necessary for the proposed project
Eureka WEF	To be announced	<ul> <li>Portion 8 of Nelspoortje No. 103</li> <li>Portion 9 of Nelspoortje No. 103</li> <li>Portion 3 of Blaauwbosch Poortje No. 66</li> <li>Remainder of Blaauwbosch Poortje No. 66</li> </ul>	<ul> <li>60 wind turbines with a total export capacity of up to 140MW. Turbines will have a hub height of up to 120m and a rotor diameter of up to 150m.</li> <li>132kV onsite Eureka IPP Substation</li> <li>The turbines will be connected via medium voltage cables to the proposed 132kV onsite Eureka IPP Substation.</li> <li>Internal access roads are proposed to be between 4m to 6m wide.</li> <li>A temporary construction lay down area.</li> <li>A hard standing area / platform per turbine.</li> <li>The operations and maintenance buildings, including an on-site spares storage building.</li> <li>Fencing (if required) will be up to 5m where required and will be either mesh or palisade.</li> </ul>

#### Table 2-2 Project Detail Eureka Wind Energy Facility

#### 2.3. Substation and Power Line Technical details

The overall objective of the project is to feed the electricity generated at the proposed Eureka Wind Energy Facility (WEF) into the National Grid.

The proposed project consists of the following main activities:

- Construction of 1 x 132kV substation (referred to as the "proposed Eureka substation")
- Construction of 1 x 132kV power line from the proposed Eureka substation to one of the following potential connection points:
  - Kronos Main Transmission Substation;
  - o Cuprum Substation; or
  - Proposed Copperton Wind Substation.

The proposed power line will consist of a series of towers located approximately 200m to 250m apart. The type of power line towers which are being considered at this stage include self-supporting suspension monopole structures where the line is relatively straight and angle strain towers where the line deviates from zero degree with a large angle. The steel monopole tower type is between 18 and 25m in height. The height will vary based on the terrain, but will ensure minimum overhead line clearances with buildings and surrounding infrastructure. The exact location of the towers will be determined during the final design stages of the power line.

A power line corridor of approximately 500m wide is being proposed to allow flexibility when determining the final route alignment, however only a 31m wide servitude would be required for the proposed 132kV power line. As such, the 31m wide servitude would be positioned within the corridor.

Two alternative sites for the proposed Eureka substation will be assessed during the Basic Assessment. The size of the substation site will be approximately 150m x 150m.

#### 2.3.6. Project Location

The proposed Eureka substation and 132kV power will be located to the east, north-east and southeast of Copperton, within the Siyathemba Local Municipality of the Pixley ka Seme District Municipality in the Northern Cape Province.



## 3. Locality of entire Project Area Assessed in this Desktop PIA study

Figure 3-1 Locality Entire Study Area reviewed in Desktop PIA

#### 4. GEOLOGY

The study area is underlain by presumably Mokolian aged Uitdraai Formation of the Brulpan Group Olifantshoek Supergroup, Carboniferous to Permian aged Dwyka Group, Karoo Supergroup and Quaternary aged Gordonia Formation of the Kalahari Group.



Figure 4-2 Geology of the Study Area. For Legends see Explanations below



Figure 4-1 Legend Geology 1



## 4.1. Olifantshoek Supergroup

## 4.1.1. Brulpan Group

#### Uitdraai Formation

The Mokolian ged Uitdraai Formation is predominantly a light to dark grey banded to massive quartzite with haematite nodules in places and subordinate quartz-sericite schist (Johnson et al, 2009).

#### 4.2. Karoo Supergroup

#### 4.2.2. Dwyka Group

The Carboniferous to Permian aged Dwyka Group consists primarily of tillite, sandstone and shale, forming the prominent outcrops in the southern part of the study area (Johnson et al, 2009)

#### 4.3. Kalahari Group

#### Gordonia Formation

The Quaternary aged Gordonia Formation underlies very large parts of the study area and consists predominantly of red coloured windblown sand as well as sand and sandy soils with calcrete that underlies the lower lying areas in the study area.

Fluvial gravels, sands, lacustrine and pan mudrocks, diatomite sand diatomaceous limestones, evaporites, consolidated to unconsolidated aeolian sands, pedocretes (especially calcrete). Late Cretaceous to Recent<90 Ma to 0 Ma.

## 4.4. Groundwater Related Features

A total of five historical spring sites and three potential fault-bounded groundwater aquifers are mapped in the study area. Without ground proofing by the Palaeontologist and following comments from SAHRA (Case ID 9810), this aspect of the Natural Heritage of the site needs to be addressed by groundwater consultants as per requirements of the National Water Act (Act no 36 of 1998) and does not form part of this Palaeontological Impact Assessment.

## 5. PALAEONTOLOGY OF THE AREA

## 5.1. Olifantshoek Supergroup

#### 5.1.1. Bulpan Group

#### Uitdraai Formation

The Mokolian aged Uitdraai Formation have not been studied for fossils up to date and due to the age it was not expected to yield any fossils. Recent research however indicate that earlier, very primitive life forms could have existed during Mogolian times and albeit very difficult to see and normally only described during detailed academic work, the recording of any mico-fossis and trace fossils, including possible algal mat structures from the study are will contribute significantly to the National Heritage Estate of the Northern Province and South Africa.

#### 5.2. Karoo Supergroup

#### 5.2.2. Dwyka Group

Trace fossils have been recorded from the fine-grained shales of the Dwyka Group in KwaZulu-Natal (Linstrom, 1987; MacRae, 1999). All of the following could potentially be found in KwaZulu-Natal. Trackways, produced mostly by fish and arthropods (invertebrates), have been recovered in shales from the uppermost Dwyka Group. Other trace fossils include coprolites (fossilized faeces) of chondrichthyians (sharks, skates and rays).

Body fossils include aranaceous foraminifera and radiolarians (single-celled organisms), bryozoans, sponge spicules (internal support elements of sponges), primitive starfish, orthoceroid nautiloids (marine invertebrates similar to the living *Nautilus*), goniatite cephalopods (*Eoasinites* sp.), gastropods (marine snails such as *Peruvispira viperdorfensis*), bivalves (*Nuculopsis* sp., *Phestia* sp., *Aphanaia haibensis, Eurydesma mytiloides*), brachiopods (*Attenuatella* sp.) and palaeoniscoid fish such as *Namaichthys schroederi* and *Watsonichthys lotzi*.

Fossil plants have also been found, including lycopods (*Leptophloem australe*), moss, leaves and stems (possibly belonging to a proto-glossopterid flora). Fossil spores and pollens (such as moss, fern and horsetail spores and primitive gymnosperm pollens) as well as fossilized wood probably belonging to primitive gymnosperms have also been recorded from Dwyka deposits (MacRae, 1999; McCarthy and Rubidge, 2005).

## 5.3. Kalahari Group

#### 5.3.3. Gordonia Formation

Palynomorphs, root casts (rhizomorphs / rhizoliths) and burrows (eg termitaria), rare vertebrate remains (mammals, fish, ostrich egg shell etc), diatoms, freshwater stromatolites, freshwater and terrestrial shells (gastropods, bivalves), ostracods, charophytes are all described from these deposits.

Fossils are mainly associated with ancient pans, lakes and river systems Palaeontology poorly studied. Basal Late Cretaceous gravels and lacustrine clays probably fossiliferous (bones, teeth, petrified wood, palynomorphs) but very. rarely exposed .Wide range of fossils can be present in these surface deposits, including mammalian bones and teeth, tortoise remains and ostrich egg shells.

## 6. GROUNDWATER HERITAGE SITES AND POTENTIAL AQUIFERS

The existing historic springs are associated with the Gordonia Formation and only one spring is clearly marked at a prominent associated fault zone. The three potential groundwater aquifers are associated with prominent fault zones in the study area. All groundwater related features do not fall under the Heritage Legislation and must be addressed by the EAP under the National Water Act (Act 36 of 1998).

## 7. PALAEONTOLOGICAL SENSITIVITY

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged (Figure 7.1). The different sensitivity classes used are explained in Table 1 above.



Figure 7-1 Palaeontological Sensitivity of the entire Study Area is presented. A Moderate sensitivity is allocated to all the geological formations. Although groundwater related features were identified during the Desktop Survey, no reference to the historic value of water is made in the literature, and the importance of these sites as well as the possible impact of the project on these sources is the responsibility of the groundwater consultant for the project.

The Mokolian aged Uitdraai Formation, Carboniferous to Permian aged Dwyka Group and Quaternary aged Gordonia Formation underlying all the alternative layouts for the Aletta as well as the Eureka WEF areas and the power line corridors are similarly rated for Palaeontological Impact.

## 8. CUMULATIVE IMPACT ASSESSMENT FOR PALAEONTOLOGY

The study area forms part of a large area in South Africa where associated applications for Wind Energy Facilities are presently considered. Following this desktop assessment it is clear that, although a Moderate Sensitivity id allocated to the entire study area, most of the fossils expected are difficult to observe and most of the fossils will only be exposed during construction phases of the projects.

Proposed Developmen t	DEA Reference Number	Current Status of EIA	Proponent	Capa city	Farm Details
The Badudex	14/12/16/3/3/2/546	EIA	Budadex	74	Portion 1 of the Farm
Solar Project		underway	(Pty) Ltd	MW	Volgelstruis Bult No 104
The Moiblox	14/12/16/3/3/2/547	EIA	Moiblox	75	Remainder of the Farm
Solar Project		underway	(Pty) Ltd	MW	Bosjesmansberg
Garob Wind	14/12/16/3/3/2/279	Awarded	Garob Wind	140	Portion 5 of the Farm
Energy		Preferred	Farm (Pty)	MW	Nelspoortje No. 103
Facility		Bidder	Ltd		
Project		Status.			
Copperton	12/12/20/2099	Awarded	Plan 8	140	Portion 4 of the Farm
Wind Energy		Preferred	Infinite	MW	Nelspoortje No. 103;
Facility		Bidder	Energy		and Portion 7 of the
		Status.	(Pty) Ltd		Farm Nelspoortje No.
					103.
Humansrus	14/12/16/3/3/2/707	Authorised	Humansrus	75	Remainder the Farm
Solar PV	14/12/16/3/3/2/708		Solar PV	MW	Humansrus No. 147
Energy			Energy		
Facility 1 and			Facility 1		
2			(Pty) Ltd		
Humansrus	14/12/16/3/3/2/888	EIA	Humansrus	75 MW	Remainder the Farm
Solar PV	14/12/16/3/3/2/887	underway	Solar PV		Humansrus No. 147
Energy			Energy		
Facility 2 and			Facility 3/4		
3			(Pty) Ltd		
Mierdam	12/12/20/2320/2	Authorised	South Africa	75	Portion 1 of the Farm
Solar			Mainstream	MW	Kaffirs Kolk No. 118
Photovoltaic			Renewable		
Facility			Power		
			Mierdam		
			(Pty) Ltd		
Platsjambok	12/12/20/2320/4	Authorised	South Africa	75 MW	Remainder of the Farm
East and	12/12/20/2320/5		Mainstream		Platsjambok 102
West Solar			Renewable		
Photovoltaic			Power		
Facility			Mierdam		
			(Pty) Ltd		

#### Table 8-1 Farms and areas where WEF's are planned in the area surrounding the study area

Proposed Developmen t	DEA Reference Number	Current Status of EIA	Proponent	Capa city	Farm Details
Helena Solar	14/12/16/3/3/2/765	EIA	BioTherm	75 MW	Portion 3 of the Farm
1, 2, and 3	14/12/16/3/3/2/766	underway	Energy		Klipgats Pan No. 117
PV energy	14/12/16/3/3/2/767		(Pty) Ltd		
facility					
Renewable	14/12/16/3/3/2/608	EIA	NK Energie	UNKN	Portion 3 of the Farm
Energy Farm	14/12/16/3/3/2/609	underway	(Pty) Ltd	OWN	Hedley Plains No. 64
near Prieska					and Portion 5 of the
					Farm Doonies Pan No.
					106
Photovoltaic	12/12/20/1722	Awarded	Mulilo	19.9	Portion 1 of the Farm
Power		Preferred	Renewable	IVIVV	Volgelstruis Bult No 104
Generation		Bidder	Energy		
Facility near		Status in	Solar PV		
Prieska		REIPPP	Prieska		
		Window 1.	(RF) (Pty)		
			Ltd		
PV Energy	12/12/20/2502	Authorised	Mulilo	100 MW	Portion 1 of the Farm
Plant near			Renewable		Volgelstruis Bult No 104
Copperton			Energy		
NA dila	40/40/00/0500	Accessed and	(Pty) Lta	75 \/\\/	Demociador of the Forme
Mullo	12/12/20/2503	Awarded	Mullio	75 10100	Remainder of the Farm
		Piddor	Solor		nuekpidas Nu. 140
FILESKAFV		Status in	Entorprisos		
		Window 3			
		Currently			
		being			
		constructed			
Mulilo	12/12/20/2501	Awarded	Mulilo	75 MW	Portion 4 of the Farm
Prieska PV		Preferred	Prieska PV		Klipgats Pan No. 117
		Bidder	(Pty) Ltd		
		Status in			
		REIPPP			
		Window 3.			
		Currently			
		being			
		constructed			
PV 2, PV 3,	14/12/16/3/3/2/486	EIA	Mulilo	75 MW	Portion 4 of the Farm
PV 4, PV 5	14/12/16/3/3/2/487	underway	Renewable		Klipgats Pan No. 117
and PV 7	14/12/16/3/3/2/488		Energy		
Energy	14/12/16/3/3/2/489		(Pty) Ltd		
Plants on the	14/12/16/3/3/2/491				

Proposed Developmen t	DEA Reference Number	Current Status of EIA	Proponent	Capa city	Farm Details
Farm Klipgats					
Pan					
PV 2, PV 3,	14/12/16/3/3/2/493	EIA	Mulilo	75 MW	Remainder of the Farm
PV 4, PV 6,	14/12/16/3/3/2/494	underway	Renewable		Hoekplaas No. 146
PV 7, PV 11	14/12/16/3/3/2/495		Energy		
and PV 12	12/12/16/3/3/2/497		(Pty) Ltd		
Solar Energy	14/12/16/3/3/2/498				
Plants on the	14/12/16/3/3/2/502				
Farm	14/12/16/3/3/2/503				
Hoekplaas					
Proposed	14/12/16/3/3/2/945	EIA	BioTherm	140M	Portion 1 of Drielings
Aletta Wind		underway	Energy	W	Pan No.101
Energy			(Pty) Ltd		Portion 2 of Drielings
Facility					Pan No.101
					Portion 3 of Drielings
					Pan No.101
					Remainder of Drielings
					Pan No.101

## 8.1. Comparative Assessment of Alternatives – Aletta Grid

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION ALTERNATIVES		
Substation Option 1	FAVOURABLE	Impact on Palaeontological Heritage will be relatively small and mitigation must include arrangements between the ECO and the HIA specialist to record any new chance finds of fossils during the construction phase of the project.
Substation Option 2	FAVOURABLE	Impact on Palaeontological Heritage will be relatively small and mitigation must include arrangements between the ECO and the HIA specialist to record any new finds of fossils during the construction phase of the project.

Alternative	Preference	Reasons (incl. potential issues)
POWER LINE CORRIDOR ALTERNAT		
Power Line Option 1 (Kronos)	FAVOURABLE	Impact on Palaeontological Heritage will be relatively small and mitigation must include must include arrangements between the ECO and the HIA specialist to record any new finds of fossils during the construction phase of the project.
Power Line Option 2 (loop in loop out)	FAVOURABLE	Impact on Palaeontological Heritage will be relatively small and mitigation must include must include arrangements between the ECO and the the HIA specialist to record any new finds of fossils during the construction phase of the project.
Power Line Option 3 (Cuprum)	FAVOURABLE	Impact on Palaeontological Heritage will be relatively small and mitigation must include must include arrangements between the ECO and the HIA specialist to record any new finds of fossils during the construction phase of the project.
Power Line Option 4 (Copperton IPP)	FAVOURABLE	Impact on Palaeontological Heritage will be relatively small and mitigation must include must include arrangements between the ECO and the HIA specialist to record any new finds of fossils during the construction phase of the project.

## 8.2. Comparative Assessment of Alternatives – Eureka Wind

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Alternative	Preference	Reasons (incl. potential issues)

Alternative	Preference	Reasons (incl. potential issues)		
SUBSTATION AND O & M BUILDING ALTERNATIVES				
Option 1	NO PREFERENCE	The areas are all underlain by		
		Moderately sensitive Palaeontological		
		formations and the proviso is that the		
		ECO must work closely with the HIA		
		specialist to ensure that all new, chance		
		finds of fossils be recorded during the		
		construction phase of the project		
Option 2	NO PREFERENCE	The areas are all underlain by		
		Moderately sensitive Palaeontological		
		formations and the proviso is that the		
		ECO must work closely with the HIA		
		specialist to ensure that all new, chance		
		finds of fossils be recorded during the		
		construction phase of the project		

## 9. CONCLUSION AND RECOMMENDATIONS

The Aletta Wind Energy Facility (WEF) will be located approximately 17km east of Copperton and the alternative Eureka Wind Energy Facility (WEF) will be located approximately 5km north-east of Copperton, with associated corridors for Power Lines, within the Siyathemba Local Municipality of The Pixley Ka Seme District Municipality in The Northern Cape Province.

The study area is underlain by presumably Mokolian aged Uitdraai Formation of the Brulpan Group Olifantshoek Supergroup, Carboniferous to Permian aged Dwyka Group, Karoo Supergroup and Quaternary aged Gordonia Formation of the Kalahari Group.

The allocation of a Moderate sensitivity for Palaeontological Heritage to the entire study area indicates that the EAP must be aware of the possible presence of fossils during the construction phase of the project and a "Chance Find Protocol" needs to be developed by a suitably qualified palaeontologist to ensure that all new finds of fossils are properly recorded according to the SAHRA principles.

Although the Uitdraai Formation can provide new information on micro-fossils of Mokolian age, these fossils are very difficult to identify and are more of academic interest. Both the Dwyka Group and Gordonia Formations are however known for some very significant fossil finds and although scarce, the fossils can contribute significantly to our understanding of depositional environments during the Carboniferous, Permain and Quaternary ages in South Africa. It is recommended that the EAP and the ECO be informed of these fossils assemblages known from these groups of rocks and to be aware of the possible presence of the fossils during exposure of rock during the construction phase of this project.

**Recommendations:** 

 The EAP as well as the ECO for this project must be made aware of the fact that sediments of the Uitdraai Formation, Bulpan Group, can contain significant micro-fossil remains, albeit mostly algal structures. The shale of the Dwyka Group can contain significant fossils and it is advisable that a Palaeontologist be appointed at the start of the construction in areas underlain by this group, to visit the site initially to ensure that no significant fossils are damaged. The Gordonia Formation is mainly windblown sand but if the EAP, ECO and/or HIA specialist observe any suspiciously looking structures during excavation into these rock types, the Palaeontologist must be informed and at least one site visit is recommended to ensure that no fossils are damaged.

- 2. All groundwater related issues must be addressed by the groundwater consultants to the project, following the prescriptions contained in the National Water Act (Act no 36 of 1998).
- 3. The recommendations must be included in the EMPr of the project.

#### 10. REFERENCES

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#### **11. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR**

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

#### **12. DECLARATION OF INDEPENDENCE**

I, Gideon Groenewald, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of palaeontological heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

Hounse E

Dr Gideon Groenewald Geologist