PALAEONTOLOGICAL IMPACT ASSESSMENT REPORT

PROPOSED CHABA WIND ENERGY FACILITY

Komga, Eastern Cape Province of South Africa
Farm 25 in the Amatola District Municipality

Developer: INNOWIND (PTY) LTD

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EXECUTIVE SUMMARY

The development of a Wind Energy Facility near Komga in the Eastern Cape is an initiative of InnoWind (Pty) Ltd. Coastal and Environmental Services (CES), as part of the Heritage Impact Assessment, commissioned this Palaeontological Impact Assessment. The purpose of this Palaeontological Impact Assessment is to identify exposed and potential palaeontological heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated.

The proposed development sites are on the farm, Thorn Park, approximately 572 ha in size on the eastern side of the N2 before the turn-off to Komga. The wind energy facility will host between 6 and 8 turbines, each with a nominal power output ranging between 2-3 Mega Watts (MW). The total potential output of the wind farm would be a maximum of 18 MW. The energy generated will be fed into the Eskom grid via the Eskom "Chaba" substation.

A basic assessment of the topography and geology of the area was made by using appropriate geological (1:250 000) maps in conjunction with Google Earth. A review of the literature on the geological formations exposed at surface in the development site and the fossils that have been associated with these geological strata was undertaken. A site field investigation was conducted on 6 June 2011, with the aim to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

The Chaba development is underlain by the Permian/Triassic Balfour Formation of the Adelaide Subgroup (shale, grey mudstones and sandstones) with dolerite intrusions. The top of the Balfour Formation is characterised by a dominantly lacustrine red mudstone deposit of the Triassic Palingkloof Member, dominated by the occurrence of fossils from the *Lystrosaurus* Assemblage Zone, which in turn is overlain by sandstone of the Triassic Katberg Formation.

The field investigation confirms that the proposed development site is underlain by sedimentary rocks of the Balfour Formation, with outcrop limited to borrow pits and road cuttings. There is a high potential for fossil material in the underlying mudstones that could be uncovered during excavations. The electricity distribution route alongside the N2 is underlain by dolerite and no fossils are expected to be found during the excavations for infrastructure associated with the construction of the Wind Energy Facility.

The Balfour Formation areas of the development site have a high palaeontological sensitivity rating. Through adequate monitoring and mitigation measures during excavations, the high impact severity can be lowered to beneficial. The exposure and subsequent reporting of fossils (that would otherwise have remained undiscovered) will be a beneficial palaeontological impact.

It is recommended that the project appointed Environmental Control Officer, trained by a palaeontologist, must inspect the outcrops during the pre-construction phase and the excavated bedrock during the construction phase. If fossil material is discovered it must be appropriately protected and the discovery reported to a palaeontologist for the removal thereof as per SAHRA's legislation

SIGNIFICANCE RATING							
Rock Unit	**Temporal Scale**	**Spatial Scale**	**Degree of Confidence**	**Impact Severity**		**Overall Significance**	
				With mitigation	**Without mitigation**	**With mitigation**	**Without mitigation**
Balfour Formation	permanent	international	possible	beneficial	very severe	beneficial	High negative

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

The development of a Wind Energy Facility near Komga in the Eastern Cape is an initiative of InnoWind (Pty) Ltd. Coastal and Environmental Services (CES), as part of the Heritage Impact Assessment, commissioned this Palaeontological Impact Assessment. The purpose of this Palaeontological Impact Assessment is to identify exposed and potential palaeontological heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated.

1.1. Legal Requirements

This report forms part of the Environmental Impact Assessment for the Chaba Wind Energy Facility and complies with the requirements for 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 Chaba Wind Energy Facility Project.

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.

2. PROPOSED DEVELOPMENT DESCRIPTION

InnoWind (Pty) Ltd, a French renewable energy generator that develops, finances, builds, operates and maintains commercial wind powered generation facilities, plans to develop a wind power generation facility on the farm known as Thorn Park, located near Komga in the Eastern Cape (Figure 2.1).

The proposed development sites are on a farm approximately 572 ha in size on the eastern side of the N2 before the turn-off to Komga. The wind energy facility will host between 6 and 8 turbines, each with a nominal power output ranging between 2-3 Mega Watts (MW). The total potential output of the wind farm would be a maximum of 18 MW. Other infrastructure associated with the proposed wind farm will include the following:

- Concrete foundations to support the wind towers.
- Approximately 5 meter wide internal access roads to each turbine.
- Underground cables connecting the wind turbines.
- A building to house the control instrumentation and backup power support.
- A storeroom for maintenance equipment.

The ultimate size of the wind turbines will depend on further technical assessments but will typically consist of rotor turbines (3 x 50m blades) with rotor diameters of around 80 - 100 meters atop a 100 meter high steel or hybrid tower. The tower and turbine design and colour will be optimised to minimise visual impact.

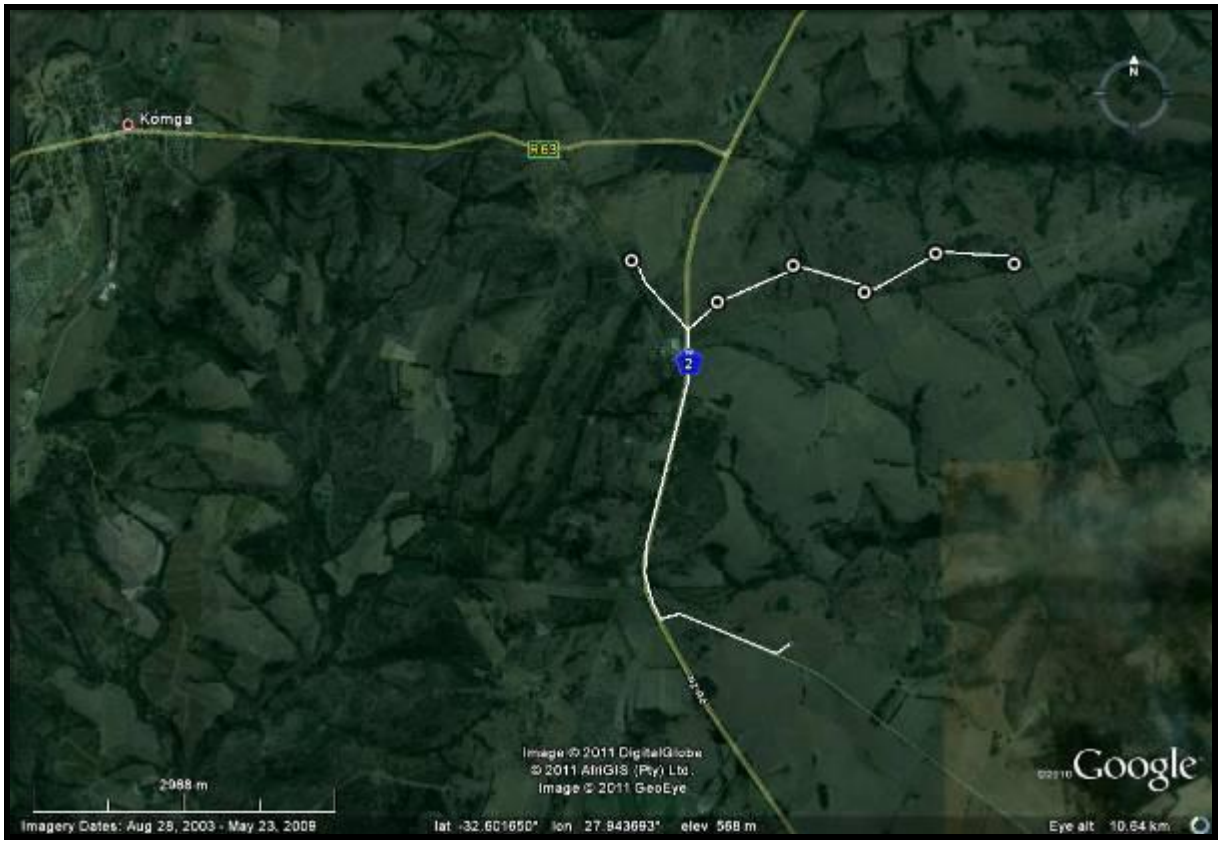

Figure 2.1 Location and Indicative Layout of the Proposed Chaba Wind Energy Facility

3. AIMS AND METHODS

Following a desk top study, reported to SAHRA during September 2009, a request for a Phase 1 Palaeontological Impact Assessment (PIA) was received. Following the *"SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports"* the aims of the PIA were:

- identifying exposed and subsurface rock formations that are considered to be palaeontologically significant;
- assessing the level of palaeontological significance of these formations;
- conducting fieldwork to assess the immediate risk to exposed fossils as well as to document and sample these localities;
- commenting on the impact of the development on these exposed and/or potential fossil resources;
- making recommendations as to how the developer should conserve or mitigate damage to these resources.

A basic assessment of the topography and geology of the area was made by using appropriate geological (1:250 000) maps in conjunction with Google Earth. A review of the literature on the geological formations exposed at surface in the development site and the fossils that have been associated with these geological strata was undertaken.

A field investigation of the site was conducted on 6 June 2011 by Dr G Groenewald and Mr T Hugo, both experienced fieldworkers. The aims of the fieldwork were to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

4. GEOLOGY OF THE AREA

The Amatola area consists predominantly of the Beaufort Group of the Karoo Supergroup. The Beaufort Group consists of the Adelaide subgroup that lies between the coast and the Amatola Mountains. The Tarkastad subgroup overlays the Adelaide subgroup between the Amatola Mountains and the Stormberg and Drakensberg ranges.

The study area is underlain by the Permian/Triassic Balfour Formation of the Adelaide Subgroup (shale, grey mudstones and sandstones) with dolerite intrusions (Figure 4.1). Soils are derived from the underlying rock and are generally shallow and low in fertility.

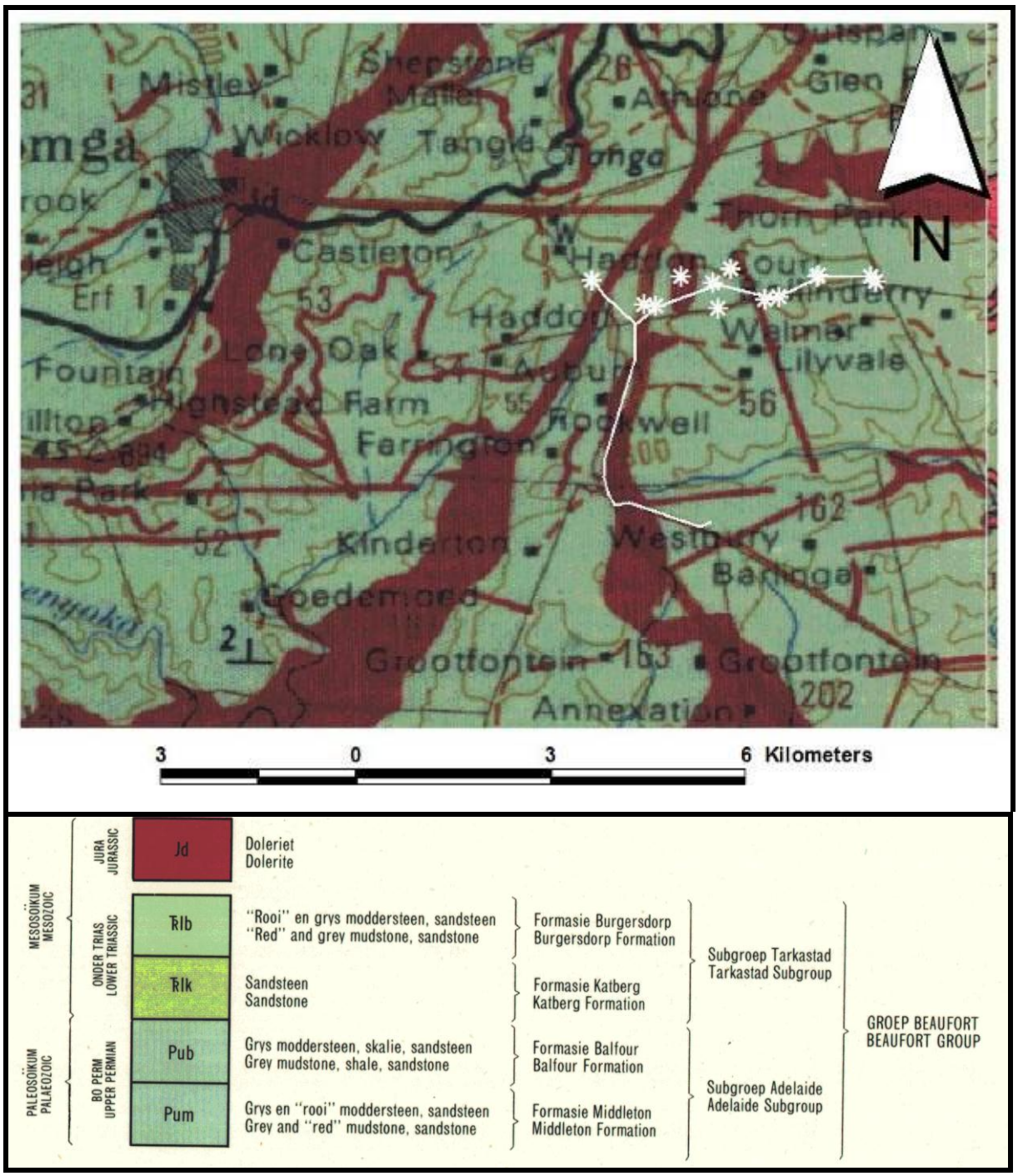

Figure 4.1 The Geology (Geo Map 3226- King William's Town) of the Chaba Development

4.1. The Balfour Formation

The Balfour Formation is interpreted as a fluvial, meandering river deposit dominated by relatively thick (4m to 70m) greenish-grey mudstone and thin (2m to 6m), albeit extensive fine-grained sandstone beds. The top of the Balfour Formation is characterised by a dominantly lacustrine red mudstone deposit of the Triassic Palingkloof Member which in turn is overlain by sandstone of the Triassic Katberg Formation (Groenewald, 1996).

4.2. Karoo Dolerite

Dolerite sill intrusions are present at the higher lying areas and along the N2 at the Chaba development area.

5. PALAEONTOLOGY OF THE AREA

5.1. The Balfour Formation

Outcrops of the grey mudstone, present in the shallow borrow pits and in outcrops associated with road cuttings, are remnants of the Balfour Formation which is associated with the *Dicynodon* Assemblage zone (Rubidge, ed, 1995). The most significant geological event recorded in this sequence is the Permian Extinction Event of approximately 250 million years ago, when an estimated 85% of all life on Earth was terminated.

The upper part of the Balfour Formation is characterised by a prominent red mudstone unit, the Triassic Palingkloof Member, dominated by the occurrence of fossils from the *Lystrosaurus* Assemblage Zone (Groenewald, 1996).

The excavations for the foundations of the turbine towers as well as the roads and other infrastructure may provide an opportunity to inspect fresh, unweathered rock of this extinction zone in the study area.

5.2. Karoo Dolerite

Due to the igneous character of this rock type it does not contain fossils.

6. FIELD INVESTIGATION

The development area is dominated by rolling hill topography (Figure 6.1). The placement of proposed wind turbines is mainly on the hill crests and upper slopes. Outcrops of the Balfour Formation are restricted to isolated burrow pits (Figure 6.2) and in road cuttings (Figure 6.3) where outcrops are exposed during road construction.

Outcrops of the Balfour Formation in borrow pits and road cuttings were intensively surveyed during the field investigation for traces of vertebrate fossils in the mudstone. No fossil material was however observed as the bedrock was severely weathered.

Figure 6.1 Rolling Hill Topography Underlain by Balfour Mudstone (S32.56900; E27.95011)

Figure 6.2 Isolated Outcrop of Balfour Mudstone in Borrow Pit (S32.58538; E27.95046)

Figure 6.3 Outcrop of Balfour Mudstone in Road Cutting (S32.56900; E27.95011)

7. PALAEONTOLOGICAL SIGNIFICANCE AND RATING

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews as well as information gathered during the field investigation. The palaeontological significance and rating as per CES supplied template is summarised in Table 7.1 and 7.2. For the methodology and definitions of impact rating and significance see *Proposed Chaba Wind Energy Facility Final Scoping Report* (CES 2011).

Table 7.1 Palaeontological Significance of Geological Units on Site

Geological Unit	Rock Type and Age	Fossil Heritage	Vertebrate Biozone	Palaeontological Sensitivity
Drakensberg Group	Dolerite Dykes & Sills (Igneous Intrusions)	None	None	Nil
Balfour Formation	Grey Mudstone & Sandstone LATE PERMIAN	Vertebrate fossils of the *Therapsids* group e.g. *Gorgonopsian* and *Dicynodonts* and Plant fossils e.g. *Glossopteris* trees and leaves.	*Lystrosaurus* Assemblage and *Dicynodon* Assemblage Zone	High sensitivity

Table 7.2 Significance Rating Table as Per CES Template

Rock Unit	Temporal Scale (duration of impact)	Spatial Scale (area in which impact will have an effect)	Degree of confidence (confidence with which one has predicted the significance of an impact)	Impact severity (severity of negative impacts, or how beneficial positive impacts would be)		Overall Significance (The combination of all the other criteria as an overall significance)	
				With mitigation	Without mitigation	With mitigation	Without mitigation
Balfour Formation	permanent	international	possible	beneficial	very severe	beneficial	High negative

There is a possibility that fossils could be encountered during excavation of non-doleritic bedrock within the development footprint and these fossils would be of international significance. If effective mitigation measures are in place at the time of exposure, and the fossils are successfully excavated for study, this would represent a beneficial palaeontological impact.

However, within the Balfour Formation, there is no way of assessing the likelihood of encountering fossils during excavation. As evidenced in other similar areas with exposures, fossils were apparently absent or very scarce over large areas but locally dense accumulations were found.

Therefore, fossils within the development site could be characterised as rare but highly significant. The damage and/or loss of these fossils due to inadequate mitigation would be a highly negative palaeontological impact. However, the exposure and subsequent reporting of fossils (that would otherwise have remained undiscovered) to a qualified palaeontologist for excavation will be a beneficial palaeontological impact.

8. PALAEONTOLOGICAL IMPACT AND MITIGATION

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews as well as information gathered during the field investigation. The field investigation confirms that most of the area is underlain by the Balfour Formation with Dolerite intrusions.

The Balfour Formation is an interbedded mud- and siltstone that do have potential to yield fossils. The excavation of foundations as well as access roads to the various turbines on the slopes will have the potential to uncover the mud rock and sandstone of the Balfour Formation. Therefore monitoring and mitigation in terms of the palaeontological heritage are required.

Due to the igneous character of Dolerite it does not contain fossils and any excavations into dolerite do not require monitoring or mitigation in terms of palaeontological heritage.

The following colour coding method was developed to classify a development area's palaeontological impact as illustrated in Figure 8.1:

- Red colouration indicates a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in all outcrops on the site/route and the chances of finding fossils during the construction phase are very high.
- Orange colouration indicates a possibility of finding fossils of a specific assemblage zone either in outcrops or in bedrock on the site/route.
- Green colouration indicates that there is no possibility of finding fossils in that section of the site/route development.

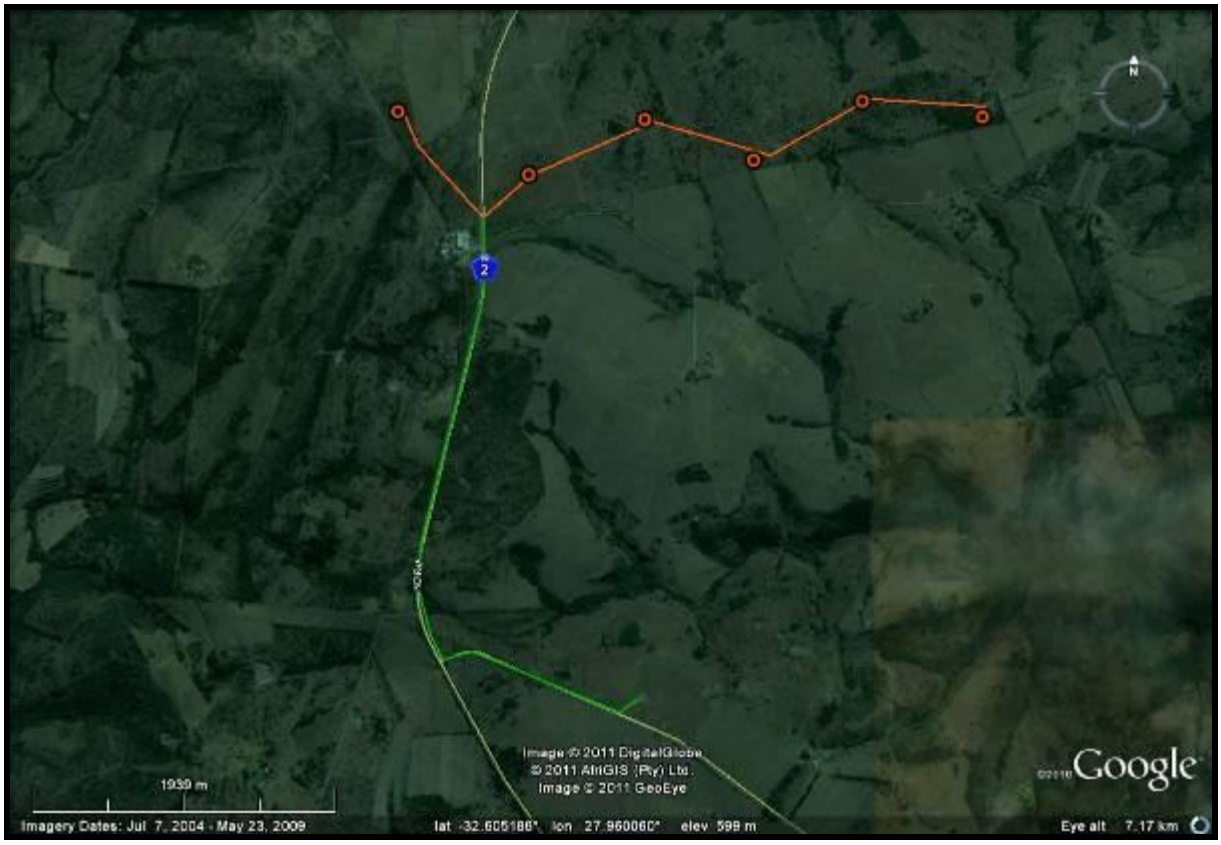

Figure 8.1 Palaeontological Impact of the Proposed Chaba Wind Energy Facility

The proposed development involves the installation of wind turbines and infrastructure such as roads and buildings. The construction phase will require excavation of bedrock and has the potential to impact directly on fossil heritage if the Balfour Formation's mudstone is exposed. From Figure 8.1 the following mitigation measures are recommended:

Table 8.1 Site Specific Mitigation Measures

Colour Coding (Figure 8.1)	Mitigation Recommended
Green Sites	Igneous or metamorphic rocks underlie these zones, with no potential for fossils.
Orange Sites	The project appointed Environmental Control Officer, trained by a palaeontologist, must inspect the outcrops during the pre-construction phase and the excavated bedrock during the construction phase. If fossil material is observed, a palaeontologist must be contracted to recover the material as per SAHRA legislation.

9. CONCLUSION

The development site for the Chaba Wind Energy Facility is underlain by the Permian to Triassic Balfour Formation, with outcrops limited to old borrow pit and road cutting sites. There is a high potential for fossil material in the underlying mudstones that could be uncovered during excavations.

The electricity distribution route alongside the N2 is underlain by dolerite and no fossils are expected to be found during the excavations for infrastructure associated with the construction of the Wind Energy Facility.

The Balfour Formation areas of the development site have a high palaeontological sensitivity rating. Through adequate monitoring and mitigation measures during excavations the high impact severity can be lowered to beneficial. The exposure and subsequent reporting of fossils (that would otherwise have remained undiscovered) to a qualified palaeontologist for excavation will have a beneficial palaeontological impact.

It is recommended that the project appointed Environmental Control Officer, trained by a palaeontologist, must inspect the outcrops during the pre-construction phase, and the excavated bedrock during the construction phase. If fossil material is discovered it must be appropriately protected and the discovery reported to a palaeontologist for the removal thereof. A permit for the collection and rescue of fossils from the Balfour Formation must be obtained from SAHRA.

10. REFERENCES

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11. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the Nelson Mandela Metropolitan University (1996) and the National Diploma in Nature Conservation from the University of South Africa (1990). 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).

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.

Dr Gideon Groenewald
Geologist