

Heritage impact assessment (scoping level) of the proposed  
Aberdeen to Droegrond 400 kV transmission line  
Western Cape Province (Central Karoo District)  
Eastern Cape Province (Kakadu District)

Prepared for

Envirovolution (Pty) Ltd

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## Executive summary

ACO Associates was appointed by Envirolution (Pty) Ltd of behalf of Eskom to undertake a heritage scoping study for the construction of a 400 kV transmission power line from the Droerivier Substation near Beaufort West to the site of Eskoms proposed Aberdeen Wind Energy Facility some 140 km to the east. Three alternative routes have been evaluated and ranked as part of this assessment. The proposed routes roughly follow the northern side of the R61 between Beaufort West and Aberdeen. The R61 is possibly one of the longest flatted stretches of straight road in the country – desolate and somewhat dreary.

This study suggests that in terms of palaeontology and archaeology, that although material does exist within this area the threat to this material is limited as the sub-surface disturbance caused is limited to a few square meters per tower. In terms of paleontology exposure of rock on these sandy flatlands of the central Karoo as few and far between, the likelihood of impacts occurring are low, while in terms of archaeology, there are no foci along any of the proposed routes that would have acted as foci for pre-colonial occupation. An aerial survey has demonstrated that vast stretches of the area consist of vegetation denuded pans and flat lands which have been heavily transformed by farmers in the interests of flash flood control and soil conservation.

In terms of the built environment and associated cultural landscape, there will be no physical impacts to heritage structures. This area is sparsely inhabited. Although all of the few farm houses that were observed in the study area contain structures and components that are greater than 60 years of age, no direct impacts will occur. Although depending on which route is favoured, some visual impact may occur to farms. None of these receptors have any heritage status that is, or has the potential to be publically commemorated as a heritage site. Thus impacts to farms and farming communities lie within the realm of social rather than a heritage impact.

In terms of alternatives, the routes enjoy equal status in the heritage sub-disciplines of archaeology, palaeontology and built environment, however subject to the findings of the visual assessment:

Alternative 2 is least favoured as it will impact the scenic qualities of the R61  
Alternative 1 is intermediary favoured (as areas adjacent to the escarpment are aesthetically fine)  
Alternative 3 is most preferred due to its isolation, and lower scenic qualities.

It must be emphasized that overall all alternatives are acceptable, and any

alternative arrived at by consensus may be considered acceptable in heritage terms.

No fatal flaws have been identified.

Key recommendations

Surface archaeology/palaeontology – archaeologist to participate in undertake walk-down of near final alignment to “steer” impacts.

Declaration:

Mr Tim Hart and Liesbet Schietecatte are independent specialist consultants who are in no way connected with the proponent, other than delivery of consulting services.

Tim Hart (MA) is an archaeologist with 24 years of working experience in heritage throughout southern Africa. He is accredited with Principal Investigator status with the Association of Professional Archaeologists of Southern Africa.

Liesbet Schietecatte (MA, MSC) is an archaeologist with 16 years of experience of working in Europe and South Africa.

## GLOSSARY

**Archaeology:** Remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

**Early Stone Age:** The archaeology of the Stone Age between 700 000 and 2500 000 years ago.

**Fossil:** Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

**Heritage:** That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

**Holocene:** The most recent geological time period which commenced 10 000 years ago.

**Late Stone Age:** The archaeology of the last 20 000 years associated with fully modern people.

**Middle Stone Age:** The archaeology of the Stone Age between 20-300 000 years ago associated with early modern humans.

**National Estate:** The collective heritage assets of the Nation

**Palaeontology:** Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

**Pleistocene:** A geological time period (of 3 million – 20 000 years ago).

**SAHRA:** South African Heritage Resources Agency – the compliance authority which protects national heritage.

**Structure (historic:)** Any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith. Protected structures are those which are over 60 years old.

Trekboer. A farmer who moves stock from locality to locality on a seasonal cycle.

Wreck (protected): A ship or an aeroplane or any part thereof that lies on land or in the sea within South Africa is protected if it is more than 60 years old.

#### Acronyms

DEA	Department of Environmental Affairs
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
HWC	Heritage Western Cape
LSA	Late Stone Age
MSA	Middle Stone Age
NHRA	National Heritage Resources Act
SAHRA	South African Heritage Resources Agency
PHS	Provincial Heritage site

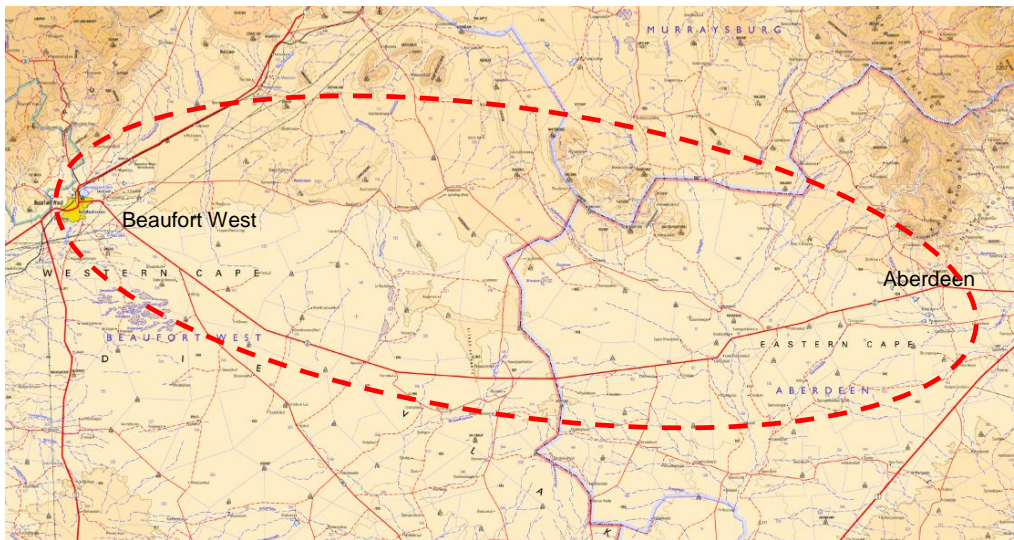
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## 1. Introduction

The ACO Associates CC was appointed by Envirolution (Pty) Ltd of behalf of the proponent Eskom to conduct a heritage impact assessment (scoping level) for the construction of a 400kV transmission lines between Droerivier substation near Beaufort West and Eskom's proposed wind energy facility at Aberdeen, a distance of some distance of 140 km. (see figure 1). The study area lies almost equally within the Western and Eastern Cape Provinces.

This proposal has triggered a full EIA process, this report being the heritage component of the of this study at the scoping level. There are three alternatives for the line route (Figure 2) and these are discussed more fully below.



**Figure 1** The location of the study area (excerpt from 1:250 000 3222-1999 ed4 Chief director surveys and mapping)

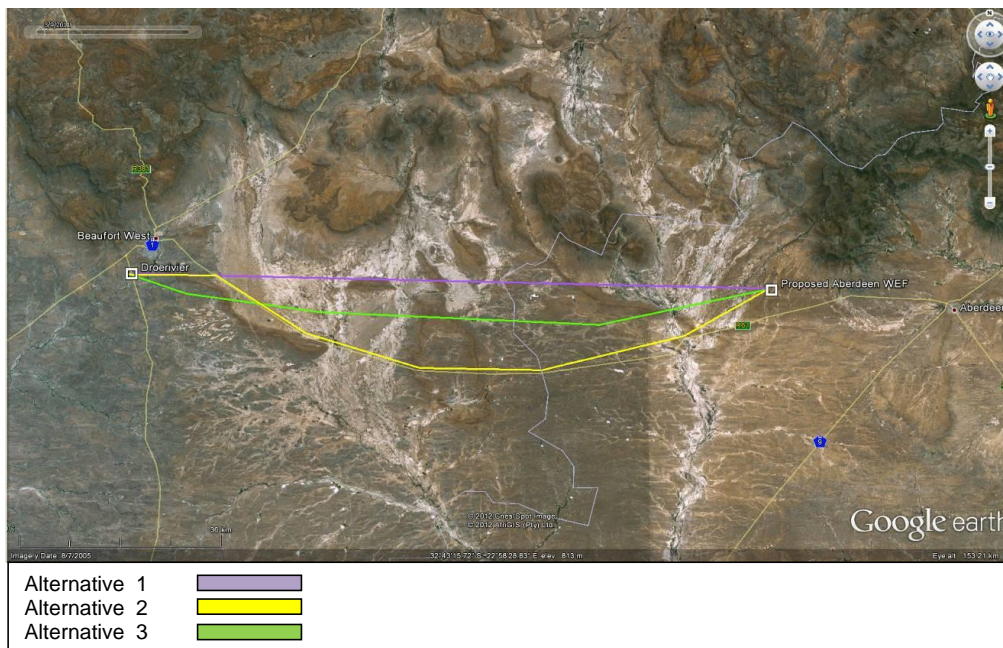
### 1.1 The need for the project

South Africa is currently experiencing an energy crisis with the national electricity provider (Eskom Holdings Limited) being unable to produce enough power to serve the nation's peak demand or projected needs to satisfy a 6% growth rate. Eskom is investigating a suite of generation options including renewable energy that will decrease the nation's dependence on the use of fossil fuels for power generation. The proposed Aberdeen Wind Energy Facility is a case in point. Power generated by

the wind energy facility needs to be evacuated to a connection point on the national grid which in this case is Droerivier – a major regional substation near Beaufort West

### 1.2 The proposal

It is proposed to construct a single 400kV line between the proposed Aberdeen facility and Droerivier substation. The preferred route mostly follows the regional road R61 between Aberdeen and Beaufort West. The servitude that is proposed lies about 1 km north and parallel to the road. Two other alternatives are proposed, one lies some 7 km further north where it crosses vast tracts of uninhabited karoo, while the third follows roughly the Orloogspoort farm road system and in parts the Kariega River Valley in the Eastern Cape Province. The alignment closest to the R61 road is attractive to the proponent in that being closer to infrastructure the logistical problems and costs associated with transport of materials is substantially lower than compared with the less accessible options.



**Figure 2** The three proposed alternatives

The associated infrastructure which will accompany the installation of the 400kV transmission line will include the following activities:

- Construction of towers (either self-supporting or guyed “V” form).



- A service road (normally a simple un-engineered track)
- The implementation of a servitude of 55 m wide which has to be kept clear of high vegetation and structures.

## **2. Methodology**

This study has been commissioned as the heritage component of an EIA. It assesses the identified range of impacts in terms of accumulated knowledge of the area. The source of information that is used for this process is based on publications and reports relating to archaeological and palaeontological work in the region. A survey of heritage resources has been conducted and visual heritage indicators such as they are, identified. conservation-worthy buildings and places celebrated as heritage). The study area has been subjected to very few comprehensive archaeological assessments in the past, most of these relating to uranium prospecting activities in the general area. The proposed WEF at Aberdeen has as yet not been subject to a detailed site survey (scoping report by Celeste Booth of Albany Museum completed to date).

Due to the remoteness of the area and the lack of access roads into the landscape, Eskom's air services were invoked and the specialist team was flown over the area at low altitude in a helicopter. Features of interest on the landscape were circled and the team was given opportunity to direct the pilot to any places that required closer attention. Following the flights, the heritage team drove whatever roads were accessible in an off road vehicle; however it very soon became apparent that physical survey of the area was subject to severe restrictions. The outcomes of the various specialist studies (biodiversity, visual, social and heritage, economic and engineering considerations) will be integrated by the EIA team to indicate the most suitable servitude alternative.

### **2.1 Assessing heritage in the context of transmission lines**

The assessment of transmission lines in terms of heritage is methodologically unlike other impact assessments that involve assessing physical landscape disturbance. Since typically transmission lines evoke the greatest change to a landscape above the ground surface, the emphasis is to assess impacts to heritage that is visually sensitive. By this we mean places or structures that are publicly celebrated as heritage or have the potential to be publicly celebrated as such. Historic farms, iconic landscapes and views, places of conflict are therefore considered important.

The following guiding principles are used;

In open landscape during daylight hours transmission lines (400 kV) on self-

supporting towers are visible (but not necessarily intrusive) from a distance of up to 5 km. Figure 3 depicts transmission lines of both the self – supporting type and compact crossrope type..

CNdV and DEAP (2006) in their development of guidelines for the establishment of wind energy facilities in the Western Cape have suggested that a buffer zone of 1 km be established around significant heritage sites to minimize the change to “sense of place”. The point at which a transmission line may be perceived as intrusive or offensive, is a subjective judgment, however in our experience lines within 1 km of a reference point are noticeable but not necessarily intrusive. After 450-500 m the lines become increasingly intrusive and become visually dominating after 100 m (depending on topography).

The presence of pre-existing transmission lines in an area serves as a mitigatory factor (rather than a cumulative negative impact) in terms of establishing new transmission lines in the same area. In other words electrical infrastructure clutter is best confined to existing areas or corridors of vertical visual disturbance, rather than introducing new vertical visual disturbance to undisturbed landscape.

While archaeological and palaeontological sites share the potential to be publically celebrated heritage places, they are less visible than structures in a landscape and are therefore less celebrated as tangible heritage with visual sensitivity. Since the impact on the land surface (figure 3) caused by transmission lines is very small (less than 1 sqm per tower in the case of guyed “V” towers, and roughly 4 sqm of footings for a conventional self-supporting tower) and reasonably adjustable at the level of final route selection, the emphasis at the impact assessment phase must focus on heritage that is visually sensitive (declared monuments, tourism heritage. scenic landscape and drives).



**Figure 3** An example to two kinds of 400 kV lines and towers. Left: conventional self-supporting towers. Right: guyed "V" towers or compact crossrope towers. Guyed "V" towers have a very small ground surface footprint and are more easily absorbed against a skyline.

The direct impact on archaeological and palaeontological sites cannot be addressed at the EIA phase in specific terms as the servitude for the transmission lines first has to be selected from several alternatives, then the final route has to be situated optimally within a typically 2 km wide corridor. Direct assessment of these impacts can only be determined at the line design and walk-down phase of the proposed activity. Mitigation can normally be achieved by micro-adjustment of tower positions and avoidance of sensitive areas.

## **2.2 Restrictions and assumptions**

The study area is thinly inhabited and remote. Within the Western Cape portion of the study area there few access roads onto the landscape. Farm gates were all locked and the lands inaccessible. Within the Eastern Cape Province the Oorlogspoort road provided a useful access point onto the landscape and enabled an opportunity to visit a few farming areas in the Kariega River flood plain. A number of farm houses were abandoned and closed up, others were actively used. At the time of doing the survey, the EIA public consultation team had not managed trace all land

owners and I&AP's which was a factor that limited access to the land.

In short the field component of this study was highly restricted, although the fly over proved extremely useful in terms of observations about the landscape, the patterns of farming and the degree to which surface transformation had taken place over wide area.

Since each of the three alternatives is situated within a two km wide study corridor, it is unfeasible to physically survey each route in detail. The positions of the towers and servitudes will be refined throughout the EIA process until a single corridor is selected. It is only at the actual design stage the final route will be known. At this point a final route walk-down will take place to make sure that physical heritage sites are identified and avoided during construction.

### **3. Legislative context**

The basis for all heritage impact assessment is the National Heritage Resources Act 25 (NHRA) of 1999, which in turn prescribes the manner in which heritage is assessed and managed.

Loosely defined, heritage is that which is inherited. The National Heritage Resources Act 25 of 1999 has defined certain kinds of heritage as being worthy of protection, by either specific or general protection mechanisms. In South Africa the law is directed towards the protection of human made heritage, although places and objects of scientific importance are covered. The National Heritage Resources Act also protects intangible heritage such as traditional activities, oral histories and places where significant events happened. Generally protected heritage which must be considered in any heritage assessment includes:

Cultural landscapes

Buildings and structures (greater than 60 years of age)

Archaeological sites (greater than 100 years of age)

Palaeontological sites and specimens

Shipwrecks and aircraft wrecks

Graves and grave yards

Living heritage

Section 38 of the NHRA requires that Heritage Impact Assessments (HIA's) are required for certain kinds of development such as rezoning of land greater than 10 000 sq m in extent or exceeding 3 or more sub-divisions, or for any activity that will alter the character or landscape of a site greater than 5000 sq m. "Standalone

HIA's" are not required where an EIA is carried out as long as the EIA contains an adequate HIA component that fulfils Section 38 provisions.

#### **4. Heritage indicators within the receiving environments**

Appendix A contains a palaeontological desktop report by Dr Graham Avery, appendix B contains observations on built environment.

##### **4.1 The landscape character**

The study area falls within one of the least populated and remotest parts of South Africa even though it is only 5 hours drive from Cape Town. The study area, which lies on the vast plains below the great escarpment extends from the Beaufort West area towards Aberdeen and the Plains of Camdeboo in the Eastern Cape.

Above the escarpment (The Nuweveld Range) the Karoo is characterised by low hills, kopjes, shale ridges and broad plains. Human settlement is sparse – many of the farm houses are un-occupied. Although technically all the land is zoned agricultural, in real terms it has the character of a wilderness. Occasional stock posts, dry stone kraals, fences, wind pumps, boundary beacons and tracks are the only apparent elements of human modification of the landscape. The treeless environment of above the escarpment is windswept and harsh, winter temperatures can be well below freezing point. Towards the east the Sneeuberg Mountains dominate the escarpment and overlook the Camdeboo. The plains below are flat and vegetated by low karoo scrub (figure 5). Stands of thorn trees are to be found in the flood plains of the Kareiga River. Human settlement is sparse being limited to a few farms along the R61 and a cluster of other in the Eastern Cape associated with the Kareiga River flood plain. The study area incorporates a major drainage system (figure 4) that is only occasionally active in periods of heavy rain or if heavy snow falls occurs on the mountains of the high escarpment. The water drains into a meandering complex of tributaries and pans ultimately draining into the Gouritz River system. It is this complex pans and low flat areas that is denuded of vegetation that gives this area its characteristic appearance – large flat and bare patches of landscape with very little relief. Hundreds of drainage channels and berms constructed by farmers are testimony to periods of flooding (figure 6).

The R61 which cuts through this landscape is long and straight, and considered to be a high accident zone due to its monotony (figure 7). It is not considered to carry high volumes of traffic nor is it a popular tourism route, but it is favoured by motorists looking for a quieter alternative to the Garden Route for reaching the Eastern Cape. The R61 is considered an uninteresting drive by many – the scenery

is bland, flat and open, yet this kind of “wide open space” scenery has its appeal and the route should be considered to have some scenic value. The R61 is the 20<sup>th</sup> century replacement of an earlier wagon road or *Voortrekker* route that meandered from farm to farm linking the Beaufort West and Graaff Reinet districts in the 19th century.



**Figure 4.** The Kariega River (Eastern Cape) and the surrounding floodplain. The Camdeboo mountains of the escarpment form the background.



**Figure 5** The R61 is roughly below the helicopter (Western Cape). The image depicts the landscape below the escarpment in a south easterly direction from the R62.





**Figure 6** Large areas, especially the pans have been transformed in the interests of veld conservation



**Figure 7** The R61.

## 4.2 Palaeontological background

The Great Karoo is one of the worlds most important repositories of palaeontological information about the evolution on both marine and terrestrial plants and animals. In popular literature it is described thus:

*"The **Karoo Supergroup** is the largest stratigraphic unit in Southern Africa, covering almost two thirds of the present land surface, including central Cape Province, almost all of Orange Free State, western Natal, much of south-east Transvaal, Zambia, Zimbabwe and Malawi. The basins in which it was deposited formed during the formation and breakup of Pangea.*

*Its strata, mostly shales and sandstones, record an almost continuous sequence of marine glacial to terrestrial deposition from the Late Carboniferous to the Early Jurassic, a period of about a hundred million years. These accumulated in a retroarc foreland basin called the "main Karoo" Basin. This basin was formed by the subduction and orogenesis along the boundary of Gondwana (the past African continent) and the Panthalassan Sea (paleo-Pacific).<sup>[5]</sup> Its sediments attain a maximum cumulative thickness of 12 km, with the overlying basaltic lavas (the Drakensberg Group) at least 1.4 km thick.<sup>[6]</sup>*

*Fossils include plants (both macro-fossils and pollen), rare insects and fish, common and diverse tetrapods (mostly therapsid reptiles, temnospondyl amphibians, and in the upper strata dinosaurs), and ichnofossils. Their biostratigraphy has been used as the international standard for global correlation of Permian to Jurassic nonmarine strata". (2012 Wikipedia: [http://en.wikipedia.org/wiki/Karoo\\_Supergroup](http://en.wikipedia.org/wiki/Karoo_Supergroup))*

A review of the Karoo Palaeontological Collection database at Iziko South African Museum indicates that fossils are more likely to occur on higher points in the raised Beaufort Group (Adelaide Subgroup) of the Permian-aged Karoo Sequence outcrops at some distance from the proposed lines. However, these rocks may be exposed throughout the area. Dolerites occur and may have trapped younger sediments that could contain fossils and sub-fossils. Details of the geology are derived from 1:250 000 Geological Series 3222 Beaufort West.

Areas in which Karoo Group fossils may occur are thus limited. Examination of borrow pits for road metal that might occur along the approved line may provide clues as to potential.

The geological map reveals extensive areas covered by Quaternary-aged alluvium with patches of calcareous and other deposits, especially around pans and river courses. These, and any alluvial deposits, could be potential sources of fossils and should be carefully assessed when the line route is approved.

It is possible that fossils or sub-fossils of interest could be encountered during any excavation that cuts into undisturbed sediments; younger sediments may contain ancient wetland deposits and/or more-recent fossils. Small pockets of bone can occur

in older dunes (often associated with pans), calcrete and alluvial deposits, for instance, or where bone accumulators like hyaenas, Jackals or porcupines used holes/burrows dug by aardvarks. Such material is studied by both specialised archaeologists and palaeontologists.

While the occurrence of fossils in underlying sediments in the area concerned may be unlikely, any excavation that penetrates into older rocks could encounter Karoo fossils (see McCarthy and Rubidge 2005 for background); Collaboration between the contractor and a suitably-qualified palaeontologist will be required when sufficient detail is available for more-accurate assessment of the approved line and decision making regarding the necessity (or not) of monitoring during construction.

#### **4.3 Archaeological background**

Formal archaeological studies in this area are very few, the closest being more than 200km away in the eastern Karoo. Because of the scarcity of caves and shelters, more than 90% of Karoo archaeological sites are open sites of stone artefacts, ostrich eggshell fragments and occasionally, pottery. Bone remains are rarely preserved. Artefacts of both the Early and Middle Stone Age are widespread and may generally be described as an ancient litter that occurs at a low frequency across the landscape. Where definable scatters of Early and Middle Stone Age material occur, they are considered to be significant heritage sites. More intensive occupation of the Karoo started around 13 000 years ago during the Later Stone Age, which is essentially the heritage of Khoisan groups who lived throughout the region. The legacy of the San includes numerous open sites while traces of their presence can also be found in most large rock shelters, often in the form of rock art. They frequently settled a short distance from permanent water sources (springs or waterholes) and made use of natural shelters such as rock outcrops or large boulders or even large bushes. In the Great Karoo natural elevated features such as dolerite dykes and ridges played a significant role in San settlement patterns.

The most detailed and comprehensive investigation of the Karoo was undertaken in the Upper Seacow River by Sampson (1988). He recorded some six thousand archaeological sites which he ascribed to Bushmen hunter-gatherers and Khoikhoi pastoralists. The archaeological remains relating to the Bushmen have been historically described as the "Smithfield Industry", and are found from the western Free State to the northern part of the Northern Cape. The Smithfield typically contains flaked lithics (on unpatinated blue-black hornfels), grinding equipment, bored stones, and potsherds (typically relating to bowl-shaped pots with stamp impressed decoration). Formal stone tools include endscrapers. Sampson also

recognized a Khoekhoen ceramic tradition and he speculates on the chronological ordering of the settlement in the valley (1988). He notes that many of the Smithfield sites occur in dense clusters, and that they are concentrated on the flat sandy patches on the foot slopes and crests of dolerite hills and ridges, usually within a half-hour walk (1km radius) of a fountain. Many of these sites are protected from the winds by low ridges and boulders, in other words shelter especially in the winter months is of paramount importance. Rock engravings do occur to the south and east of Beaufort West on dolerite boulders. In the context of this study area, it is essentially featureless and lacks the foci that would have been attractive to San groups for settlement. There is little doubts that they would have been in the area, especially during seasonal rains, however the likelihood of locating archaeological sites that represent long periods of occupation is low.

The introduction of pastoralism (sheep and goats, later cattle) roughly 2000 years along with the arrival of the Khoekhoen was a significant event that broke the ancient tradition of hunting and gathering. According to the historic records the Khoikhoi herders were divided into large tribal communities, distributed along the coastal plains and up as far as Graaff Reinet. These transhumant communities (herding cattle and sheep) may have utilized the grazing opportunities of the Karoo on a seasonal basis but information on this is sketchy. Recent evidence has revealed the presence of early stone stock kraals (Hart 2010) in the high Karoo near Sutherland as well as on the escarpment of the eastern karoo in the Sneeuberg Mountains (Sampson et al 1989). The Khoikhoi herder occupation of the central karoo appears to have been sporadic and pulsed with climatic event such as the "little Ice Age" (circa 1400 AD) when high rainfall and grasses made arid areas suitable for stock keeping. The San (bushmen) appear to have retreated to the Great Karoo with the arrival of the first Dutch Trekboers in the mid-18th century where the launched a fierce resistance against the newcomers.

#### **4.4 Colonial expansion**

The indigenous people of Karoo waged a bitter war against colonial expansion as they gradually lost control of their traditional land. Penn (2005) notes the most determined indigenous resistance to *Trekboer* expansion occurred when they entered the harsh environment of the escarpment of the interior plateau (namely Hantam, Roggeveld and Nieuweveld Mountains). Similarly *Trekboer* settlers find their progress onto the upper escarpment halted as the Sneeuberg San launched an almost successful campaign to drive them out. Numerous place names throughout the Karoo such as Oorlogspoort and Oorlogskloof are testimony the skirmishes of the late 18th century. The situation became so desperate that the colonists fought back

by establishing the "Kommando" system – the "hunting" of San was officially sanctioned in 1777 (Dooling 2007) and in some instances bounties were obtainable from the local landroost. The Drosdy of Graaf Reinett played a significant role in this long and bitter war which eventually saw the almost complete destruction of the Karoo bushmen.

The *Trekboere* settled on the escarpment where most of the springs were found, from here they were able to exploit the vegetation of the Onder-karoo on a seasonal basis. These European pastoralists were highly mobile; trekking between winter and summer grazing on and off the escarpment. Land ownership was informal, and only became regulated after the implementation of the quitrent system used by the Government to control the lives and activities of the farmers.

The two major regional centers in the area, Beaufort West and Graaf Reinett were established as administrative centers to exert hegemony of the activities of the *Trekboere* who were prone to behave as free agents without governance. Of the two centers, Graaf Reinett, is the oldest being established under the Dutch rule at the Cape as a legal and administrative center. The town has an extraordinarily colourful history, as being so remote from Cape Town, its citizens were inclined to exert independence to the point that Graaff Reinett was the seat of several rebellions, and for a period a self-proclaimed republic. The appointment of the a firm-handed administrator, Andries Stockenström saw the dissent quelled, and ongoing problems for farmers caused by the Sneeuberg San brought to an end by force of arms. Graaf Reinett is considered to contain a fine collection of historic buildings and streetscapes (Franzen 2006).

The central Karoo region was administered from the Drosdy at Tulbagh. Given the problems of law enforcement in remote regions Stockenström motivated the establishment of a sub-drosdy on the farms Hooivlakte and Bosjesmansberg. The farms were procured in 1818 and a new district was proclaimed. The new district and town subsequently became known as Beaufort West. The town was laid out in 1820 and furrows, channelling water, were constructed along the streets. Beaufort West became a municipality in 1836, making it the oldest in the country. The railway from Cape Town reached the town in 1880 and it became a major locomotive depot and marshalling yard on the way to the north (Bulpin 1986, Franssen 2006).

Unlike Graaf Reinett and Beaufort West, Aberdeen was not established as an administrative center but grew as a typical *Kerksdorp* (church town). Aberdeen was founded when the Nederduits-Gereformeerde Kerk (Dutch Reformed Church) of Graaf Reinett gave permission for the establishment of a new congregation on 10 September 1855 to provide for the religious needs of the Camdeboo Farmers. The

farm Brakkefontein had been bought for this purpose by Jan Vorster. Once the church had been built, settlement on the farm commenced. A formal town plan was commissioned in 1858 and the town was named Aberdeen, after the birth place of the Scottish minister, Andrew Murray who was a major figure in the Graaf Reinet district.

## **5. Comparative impacts of the alternatives**

### **5.1 Activities that will affect the heritage environment**

The transmission lines will consist of overhead cables suspended from towers placed 400-500 m apart. Each steel tower will need to be mounted on 4 concrete footings (1 sqm each) in the case of self-supporting towers or a single 1 sqm foundation (in the case of guyed "V" towers) set into the ground surface. Hence each point of land surface disturbance is confined to the few square meters of the towers bases. The actual servitude will require a service road (normally an unpaved track) while the corridor will have to be cleared of tree cover. During construction the landscape will be subject to a period of temporary disturbance when construction equipment is brought onto site for building of the towers and lifting of the cables.

Heritage sites can be negatively affected through disturbance of the land surface, destruction of significant structures and places as well as any action that will alter the feel and appearance of an historic place or building. Hence, transmission lines are likely to result in moderate impacts to the land surface during the construction phase but permanent changes in terms of visual impacts and changes to the feel of a landscape.

The transmission lines will be visible to any receptor within 5 kms, but the degree that they would be considered unsightly or intrusive is a subjective perception. For purposes of this study the position has been taken that a transmission line situated within 500 m of a heritage site will negatively affect the setting of that heritage site.

The following potential impacts on heritage resources for the alternatives have been identified.

### **5.2 Alternative 1**

*Western Cape:* Alternative 1 represents a direct route from Droerivier to the proposed Aberdeen WEF. Of the three alternatives, this is the most northerly route.

Within the Cape Province the route crosses the R61 a short distance from Droegrond substation, then crosses the vast flat landscape of the Farm "Vetkuil" and Elandsfontein without encroaching on any known heritage sites.

*Eastern Cape:* On entering the Eastern Cape the route passes roughly 500 m south of the Farm complex known as De Panne. There is a large Victorian period farm house here with a front *stoep* and corrugated iron roof as well as several outbuildings. The buildings can be considered to be of some conservation potential, although restrictions in accessing the farm, did not allow for an accurate grade to be assigned. The line continues in an easterly direction crossing an extensive complex of old pans and transformed landscapes. The farm of Bokvlei lies some 0.7km to the north of the route. Bokvlei is actively farmed consisting of complex of farm buildings and workers cottages. Its heritage status is unclear, however indications are that a number of buildings are recent or modernized, although the core of the main house probably contains historic fabric. The proposed route then continues eastwards into the Oorlogspoort area where it passes to the north of the farm Rooidraai (1.7km), crosses the low Kariega flood plain before entering the site of the proposed Aberdeen WEF.

#### 5.2.1 Impacts Palaeontological heritage

There is a low possibility of impacts occurring if excavations for footings penetrate the older Karoo sedimentary rocks. There is also a low possibility that younger fossils together with earlier archaeology may be encountered in surface deposits and fossil dune associated with pan areas.

Mitigation: Collaboration between the contractor and a suitably-qualified palaeontologist will be required when sufficient detail is available for more-accurate assessment of the approved line and decision making regarding the necessity (or not) of monitoring during construction.

#### 5.2.2 Impacts Pre-colonial heritage

All the proposed routes are likely to have a similar impact on pre-colonial heritage, which given the small relative footprint of the proposed activity is likely to be of low significance.

The activity may displace artefactual material of the Middle Stone Age and Early Stone Age which has been documented to have a wide pattern of dispersal throughout the area, Archaeological sites that can be discretely delimited are very rare in this area (Halkett 2010), Hart and Webley (2010). The impacts that will



occur are likely to be highly localised and of low significance.

Mitigation: In most instances mitigation will not be necessary, however if a scatter is found to be dense or discrete, the tower and service tracks positions will need to be subject to minor adjustment to avoid impacts.

There is a possibility that Late Stone Age sites relating to the heritage of the Khoikhoi herders or San hunter gatherers will occur as isolated occurrences in the proposed corridor close to any place that was a spring in the past, and as experience has shown, under thorn trees along river banks and flood plains. There are no other geographic features on the landscape in this area that would have acted as a focus that would have attracted consistent occupation. There is a low possibility that significant impacts will occur.

Mitigation: The walk-down of the preferred route will be an all-important phase in this project as it is only at this time that the real extent of impacts can be judged. It is expected that micro-adjustment of tower positions and service road routes will have a high possibility of achieving complete mitigation through avoiding the impact. If this is not possible, the site will need to be sampled to create a permanent archive of knowledge and material.

#### 5.2.3 Impacts to colonial period heritage

Impacts to colonial period heritage are expected to be confined to changes to the quality of the setting of farm houses at De Panne and Bokvlei. These are not celebrated heritage sites, therefore the realm of the impact is of a social nature in terms of the owners and occupants of those farms. Physical damage to the farm buildings is not expected. There is a low possibility that the route will encounter remnants of historical occupation of the landscape, however there is no evidence of significant ruins along the route. Grave yards, marked or unmarked have not been observed, but may nevertheless occur. Generally impacts are expected to be localised and of very low significance.

The walk-down of the preferred route will be an all-important phase in this project as it is only at this time that the real extent of impacts can be judged. It is expected that micro-adjustment of tower positions and service road routes will have a high possibility of achieving complete mitigation through avoiding any impacts. If this is not possible, historic sites will need to be documented and/or excavated to obtain a permanent archive of knowledge and material.

#### 5.2.4 Cultural Landscape and setting

Alternative 1 passes through possibly the best quality of landscape in the study area as the majestic backdrop of the escarpment is closer. Combined with the sense of remoteness and wide open spaces the combination of these qualities is pleasing to the senses, however it can be argued that this is a remote area that is moderately used for tourism purposes although the Farm "Vetkuil" in the Western Cape offers hunting safaris and accommodation. No impacts to the R61 will occur, however the landscape quality in the remote areas will be impacted by the proposed activity as within a 2km wide corridor the proposed transmission lines will be directly visible to any receptor.

The change to landscape setting caused by transmission lines cannot be mitigated but the use of towers such as the guyed "v" shaped lattice towers will assist as they are better "absorbed" into a landscape.

### 5.3 Alternative 2

*Western Cape:* Alternative 2 runs due east from Droerivier substation until it reaches the R61 at which point it turns South East and follows the R61 on its northern side all the way to the proposed Aberdeen WEF. The proposed servitude lies between 500 and 700 m north of the R61, and will therefore be visible for the entire duration of the drive from outside of Beaufort West to the Eastern Cape border.

*Eastern Cape:* From the Western Cape border the route spreads slightly away northwards of the R61 to a maximum of 2.6 km until the Kareiga River floodplain. The farm buildings of upper Kiewietskuil lie some 800 m to the north of the proposed route while the farm of Kariegasfontein lies 1.40 km south of the proposed route (neither of these farms are recognized heritage sites although there is a likelihood that there is old fabric incorporated in the farm buildings). The meandering flood plain of the Kareiga River shows abundant evidence of transformation through construction of drainage channels and small embankments.

#### 5.3.1 Impacts Palaeontological heritage

There is a low possibility of impacts occurring if excavations for footings penetrate the older Karoo sedimentary rocks. There is also a low possibility that younger fossils together with earlier archaeology may be encountered in surface deposits and fossil dune associated with pan areas.

Mitigation: Collaboration between the contractor and a suitably-qualified palaeontologist will be required when sufficient detail is available for more-accurate assessment of the approved line and decision making regarding the necessity (or not) of monitoring during construction.

#### 5.3.2 Impacts Pre-colonial heritage

All the proposed routes are likely to have a similar impact on pre-colonial heritage, which given the small relative footprint of the proposed activity is likely to be of low significance.

The activity may displace artefactual material of the Middle Stone Age and Early Stone Age which has been documented to have a wide pattern of dispersal throughout the area, Archaeological sites that can be discretely delimited are very rare in this area (Halkett 2010), Hart and Webley (2010). The impacts that will occur are likely to be highly localised and of low significance.

Mitigation: In most instances mitigation will not be necessary, however if a scatter is found to be dense or discrete, the tower and service tracks positions will need to be subject to minor adjustment to avoid impacts.

There is a possibility that Late Stone Age sites relating to the heritage of the Khoikhoi herders or San hunter gatherers will occur as isolated occurrences along the proposed route close to any place that was a spring in the past, and as experience has shown, under thorn trees along river banks and flood plains. There are no other geographic features on the landscape in this area that would have acted as a focus that would have attracted consistent occupation. There is a low possibility that significant impacts will occur.

Mitigation: The walk-down of the preferred route will be an all-important phase in this project as it is only at this time that the real extent of impacts can be judged. It is expected that micro-adjustment of tower positions and service road routes will have a high possibility of achieving complete mitigation through avoiding the impact. If this is not possible, the site will need to be sampled to create a permanent archive of knowledge and material.

#### 5.3.3 Impacts to colonial period

*Historic roads:* The R61 is not a heritage road in itself as it replaced an old wagon route that meandered across the landscape from farm to farm eventually linking the towns. This old wagon route is still used in part as a farming road, however it is largely in dis-use but remains traceable on aerial photographs. It is situated mainly

a kilometre or two south of the existing R61 in the Western Cape but does penetrate further northwards crossed by the R61 in the Eastern Cape portion of the study area. It will be un-affected by the proposal.

*Western Cape:* There are no colonial period heritage sites that will be affected within the Western Cape. The walk-down of the preferred route will be an all-important phase in this project as it is only at this time that the real extent of impacts can be judged. It is expected that micro-adjustment of tower positions and service road routes will have a high possibility of achieving complete mitigation through avoiding any impacts. If this is not possible, historic sites will need to be documented and/or excavated to obtain a permanent archive of knowledge and material.

*Eastern Cape:* The built environment will be largely un-affected, however it should be noted that farm buildings at Kariegafontein off the R61 lie 1.3 km south of the proposed route. The study revealed the presence of a ruin and abandoned kraals on the east bank of the Kariega flood plain (23 32 42.63S 31 21 8.20E) . These lie 120 m south of the proposed transmission line route and therefore will not be affected. The ruins must be evaluated during the walk- down phase of the project.

#### 5.3.4 Cultural Landscape and setting

The primary concern is the visual impact that this proposed corridor will have on the R61 which will have to be assessed in the visual impact assessment. It is however clear that the transmission lines will be visible, and potentially intrusive on the scenic values of the R61. This impact will be one of medium significance as the R61 itself between Aberdeen and Beaufort West evokes different perceptions of landscape values – for some the long drive through monotonous open space is considered dreary, while others enjoy the open and distant backdrop of the escarpment. The impact is difficult to assess as the aesthetic qualities of the landscape in this area is difficult to pin a value to. Since scenery and scenic routes are considered to be a form of heritage, integration of the findings of the visual study into the heritage component of the EIA is necessary.

The change to landscape setting caused by transmission lines cannot be mitigated but the use of towers such as the guyed "v" shaped lattice towers will assist as they are better "absorbed" into a landscape. Another possible option would be to place the transmission lines as far as possible to the northern side of the 2km study corridor. While this would not render them invisible from the R61 but it will significantly decrease their intrusiveness.

## 5.4 Alternative 3

The proposed corridor for alternative 3 traverses the landscape between alternatives 1 and 2 generally about 7 km north of the R61. The route largely avoids impacts to any farms that have conservation value, but there may be social impact concerns relating to farming operations to the south of Beaufort West close to the Droerivier substation. The landscapes involved are primarily plains and floodplains of the Kariega River. The proposed corridor is extremely remote and sparsely populated.

### 5.4.1 Impacts Palaeontological heritage

There is a low possibility of impacts occurring if excavations for footings penetrate the older Karoo sedimentary rocks. There is also a low possibility that younger fossils together with earlier archaeology may be encountered in surface deposits and fossil dune associated with pan areas.

Mitigation: Collaboration between the contractor and a suitably-qualified palaeontologist will be required when sufficient detail is available for more-accurate assessment of the approved line and decision making regarding the necessity (or not) of monitoring during construction.

### 5.4.2 Impacts Pre-colonial heritage

All the proposed routes are likely to have a similar impact on pre-colonial heritage, which given the small relative footprint of the proposed activity is likely to be of low significance.

The activity may displace artefactual material of the Middle Stone Age and Early Stone Age which has been documented to have a wide pattern of dispersal throughout the area. Archaeological sites that can be discretely delimited are very rare in this area (Halkett 2010), Hart and Webley (2010). The impacts that will occur are likely to be highly localised and of low significance.

Mitigation: In most instances mitigation will not be necessary, however if a scatter is found to be dense or discrete, the tower and service tracks positions will need to be subject to minor adjustment to avoid impacts.

There is a possibility that Late Stone Age sites relating to the heritage of the Khoikhoi herders or San hunter gatherers will occur as isolated occurrences along the proposed route close to any place that was a spring in the past, and as experience has shown, under thorn trees along river banks and flood plains. There are no other

geographic features on the landscape in this area that would have acted as a focus that would have attracted consistent occupation. There is a low possibility that significant impacts will occur.

Mitigation: The walk-down of the preferred route will be an all-important phase in this project as it is only at this time that the real extent of impacts can be judged. It is expected that micro-adjustment of tower positions and service road routes will have a high possibility of achieving complete mitigation through avoiding the impact. If this is not possible, the site will need to be sampled to create a permanent archive of knowledge and material.

#### 5.4.3 Impacts to colonial period

*Western Cape:* There are no colonial period heritage sites that have been identified that will be affected within the Western Cape. The walk-down of the preferred route will be an all-important phase in this project as it is only at this time that the real extent of impacts can be judged.

*Eastern Cape:* The built environment will be largely un-affected, however it should be noted that farm buildings at Rooidraai lie 1.3 km south of the proposed route. These buildings are likely to contain some 19th century fabric, but will not be physically or aesthetically affected by the proposal.

Mitigation: It is expected that micro-adjustment of tower positions and service road routes will have a high possibility of achieving complete mitigation through avoiding any impacts. If this is not possible, historic sites will need to be documented and/or excavated to obtain a permanent archive of knowledge and material.

#### 5.4.4 Cultural Landscape and setting

The remoteness of this corridor is such that visual receptors are likely to be few. The landscape although agricultural in use, is to all intents a desolate wilderness. The sense of remoteness will be impacted by any new industrial presence, however since so few people have access to this area it is inappropriate to suggest that significant impacts will occur.

## 6. Ranking of the alternatives

In strictly heritage terms the three alternatives have similar or equal merit. In terms of predicted archaeological and palaeontological impacts, there are no indications that one alternative should be favoured over another. Similarly the heritage

concerns relating to the built environment are relatively inconsequential.

If however one builds in the issue of scenic values of the landscape, it is possible to compile a ranking of alternatives but this is subject to adjustment pending outcomes of social and visual assessments.

*Least Preferred:* Alternative 2. Subject to the findings of the visual impact assessment, alternative 2 will negatively impact the scenic amenity values of the R61 and the experience of the motorist on this route.

*Medium preferred:* Alternative 1. The scenic qualities of the landscape in the area of alternative 1 are good as the open plains set against the closer backdrop of the escarpment has aesthetic appeal. It is noted that some farming operations (such as Vetkuil) operate hunting and accommodation facilities, An industrial intrusion on the landscape will affect the wilderness qualities that such operations depend on for imparting an outdoor experience for their clients.

*Most preferred:* Alternative 3. While this route shares the scenic values of alternative 1, the backdrop of the escarpment is less pronounced therefore the landscape has less aesthetic appeal.

Overall, none of the proposed alternative raise any heritage issue that would result in an alternative being clearly unacceptable, which means that there is latitude to consider other environmental and economic factors as being of higher importance in terms of the selection of the overall favoured alternative.

## **7. Recommendations**

Subject to the recommendations of the heritage authorities in the Eastern and Western Cape Provinces it is not considered necessary to return to site for the assessment phase of the project unless additional concerns arise through the public process that will need a site inspection to resolve.

A critical component of controlling impacts to all aspects of heritage is the fact that a walk-down of the final alternative must take place as it is only at this stage will it be possible on a micro-scale control the impacts that service roads and tower footings will have on all physical aspects of heritage.

The walk-down phase should include:

- At site inspection by a palaeontologist once the technical parameters of the project are established.
- The recording of the positions and contents of archaeological sites by an archaeologist.
- The recording of ruins, farm buildings and historic features within the proposed servitude.
- The identification of graves within or close to the proposed servitude
- The presentation of such findings to the proponent for their consideration in terms of placement of infrastructure.
- The lodging of the findings with the regional heritage bodies.

## **8. Conclusion**

The proposed activity is considered acceptable in heritage terms. The three proposed alternatives have equal merit in terms of impacts to heritage, however in terms of the scenic values of the landscape a ranking is indicated which must before finalization take into account the findings of the visual and social studies.

In general the study area is of limited heritage sensitivity. The low physical impact of the proposed activity has a low chance of significantly affecting any heritage sites, places, buildings, palaeontology, archaeology or objects. It is anticipated that successful mitigation of impacts is expected to be achievable provided that a walk-down is carried out and minor adjustments to the final route and tower footing positions is carried out.

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Appendix A Palaeontological specialist report.

# **Palaeontological Assessment Proposed new Eskom Line Between Beaufort West and Aberdeen**

Prepared by

**Graham Avery**  
(Sole Proprietor)

Archaeozoology, Stone Age Archaeology and Quaternary Palaeontology

August, 2012

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## 10. Executive Summary

Graham Avery was commissioned by T Hart, ACO Associates, on behalf of Eskom to conduct a desktop study of the palaeontological potential along the area to be covered by a proposed new electricity supply line between Beaufort West and Aberdeen.

Applicant: Eskom  
Proposed activity: New 400 kV Electricity Transmission Line  
Location: Between Beaufort West Droerivier substation (Western Cape Province) and Aberdeen proposed wind energy facility (Eastern Cape Province).

The area specified in the proposals is relatively flat and has been variously ploughed, grazed and disturbed over time. A review of the Karoo Palaeontological Collection database at Iziko South African Museum indicates that fossils are more likely to occur on higher points in the raised Beaufort Group (Adelaide Subgroup) of the Permian-aged Karoo Sequence outcrops at some distance from the proposed lines. However, these rocks may be exposed throughout the area. Dolerites occur and may have trapped sediments that could contain fossils and sub-fossils. Details of the geology are derived from 1:250 000 Geological Series 3222 Beaufort West.

The archaeological field report does not mention any surface occurrence of mineralized bone. However, the above geological map reveals extensive areas covered by Quaternary-aged alluvium with patches of calcareous and other deposits, especially around pans and river courses. These, and any alluvial deposits, could be potential sources of fossils and should be carefully assessed when the line route is approved.

While the finding of fossils in underlying sediments in the area concerned is probably unlikely, any excavation that penetrates into underlying older rocks may encounter Karoo fossils (see McCarthy and Rubidge 2005 for background); old borrow pits for road metal may offer clues and younger sediments may contain ancient wetland deposits, which preserve pollens and/or more-recent fossils. Collaboration between the developer/contractor and a suitably-qualified palaeontologist will be required when sufficient detail is available for more-accurate assessment of the approved line and decision-making regarding the necessity (or not) of monitoring during construction.

Geotechnical information and details of the depth to which any excavations will extend would assist in assessing whether monitoring will be necessary.

**Provided that the recommendations of this assessment are complied with, there is no palaeontological reason why the proposed development should not proceed.**

## 11. Location of the proposed line

Alternative routes have been provided. Essentially, they can be treated as one at this stage. The proposed area extends over several 1:50 000 topographical maps. Here Google Earth coverage is provided (Figures 1, 2).



**Figure 1. The location of the study area.**



**Figure 2. Location of the 3 alternative routes.**

## 12. Method

Details of alternative line routes were provided. A desktop study was conducted, by Dr G. Avery, Archaeozoologist. In addition to examining records in Iziko South African Museum's Karoo Palaeontology Collection database, a geological map and Google Earth images were consulted.



Details of the underlying sediments are derived from 1:250 000 Geological Series 3222 Beaufort West.

### **13. Results of Survey**

The area is relatively flat and has been modified by agricultural activity. Old bone is not normally preserved in such deposits. However, it is possible that fossils could be encountered during any excavation that cuts into older sediments/rock formations.

A review of the Karoo Palaeontological Collection database at Iziko South African Museum indicates that fossils are more likely to occur on higher points in the raised Beaufort Group (Adelaide Subgroup) of the Permian-aged Karoo Sequence outcrops at some distance from the proposed lines. However, these rocks may be exposed throughout the area. Dolerites occur and may have trapped younger sediments that could contain fossils and sub-fossils. Details of the geology are derived from 1:250 000 Geological Series 3222 Beaufort West.

Areas in which Karoo Group fossils may occur are thus limited. Examination of borrow pits for road metal that might occur along the approved line may provide clues as to potential.

The archaeological field report does not mention any surface occurrence of mineralized bone (T. Hart, ACO, pers.comm.). However, the above geological map reveals extensive areas covered by Quaternary-aged alluvium with patches of calcareous and other deposits, especially around pans and river courses. These, and any alluvial deposits, could be potential sources of fossils and should be carefully assessed when the line route is approved.

It is possible that fossils or sub-fossils of interest could be encountered during any excavation that cuts into undisturbed sediments; younger sediments may contain ancient wetland deposits and/or more-recent fossils. Small pockets of bone can occur in older dunes (often associated with pans), calcrete and alluvial deposits, for instance, or where bone accumulators like hyaenas, Jackals or porcupines used holes/burrows dug by aardvarks.

While the occurrence of fossils in underlying sediments in the area concerned may be unlikely, any excavation that penetrates into older rocks could encounter Karoo fossils (see McCarthy and Rubidge 2005 for background); Collaboration between the contractor and a suitably-qualified palaeontologist will be required when sufficient detail is available for more-accurate assessment of the approved line and decision making regarding the necessity (or not) of monitoring during construction.

Geotechnical information and details of the depth to which any excavations will extend would assist in assessing whether and where monitoring will be necessary.

### **Comments**

Occurrence of palaeontological material along the proposed line routes is unlikely. Geotechnical information and details of the depth to which any excavations will extend would assist in assessing whether and where monitoring will be necessary.

While it is unlikely that fossils will be encountered during excavation of foundations, it should be borne in mind that small pockets of bone can occur in younger deposits where bone accumulators like hyaenas, jackals or porcupines used holes/burrows dug by, for instance, aardvarks.

Good communication with the developer and contractors regarding on-site monitoring during excavations will be required.

Permits from the appropriate Heritage agencies will be required, preferably ahead of any construction activity.

#### **14. Conclusion**

The likelihood that palaeontological remains will be encountered during construction of the proposed line is small but, if encountered, such material is important and must be recorded by an appropriately-qualified person.

Provided that the recommendations in this report are followed, current information indicates that the proposed line will not impact significantly on palaeontological remains. Appropriately conducted the development may provide opportunities to access rare fossil material and to better understand the local geological sequence.

**From the palaeontological perspective the development can be allowed to proceed.**

#### **15.**

#### **16. Recommendations**

If possible, geotechnical information together with the proposed depths of excavations for foundations should be provided prior to the commencement of construction. This may enable a better estimation of the time(s) when monitoring might be necessary.

Excavations for foundations in areas where it is determined that fossils may be encountered should be monitored; the frequency of this is to be worked out *a priori*, once the line route is approved, by an appropriately-qualified palaeontologist and the developer/contractor to minimize time spent on site.

Protocols for dealing with palaeontological/palynological monitoring/mitigation must be included in the Environmental Management Plan (EMP). Any such material is likely to be fragile and due care must be exercised.

Any material recovered will be lodged in the palaeontological collections of Iziko South African Museum.

Funds must be available *a priori* to cover costs.

#### **17. Heritage Permits Required**

The primary heritage legislation that needs to be considered is The South African Heritage Resources Act 25 of 1999 and regulations (details at [www.sahra.org.za](http://www.sahra.org.za)).

Clearance in terms of the National Heritage Act of 1999 and Amendments will be required before the development can proceed.

It is important that, to obviate possible delays should fossil material be encountered, permits (from both the Western Cape Provincial Heritage Agency and the Eastern Cape Provincial Heritage Agency) must be applied for ahead of construction. This would enable the monitor to readily recover material, should it be encountered during construction activities without delay.

### 18. Acknowledgements

Thanks are due to Mrs. S. Kaal, Collection Manager: Karoo Palaeontology, Iziko South African Museum, for extracting the data referred to. T Hart provided Figures 1 and 2.

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Appendix B Built environment observations.

Eastern Cape



Figure 9 Farm Bokvlei relative to proposed Alternative 1 (Above left). Bokvlei (above right).

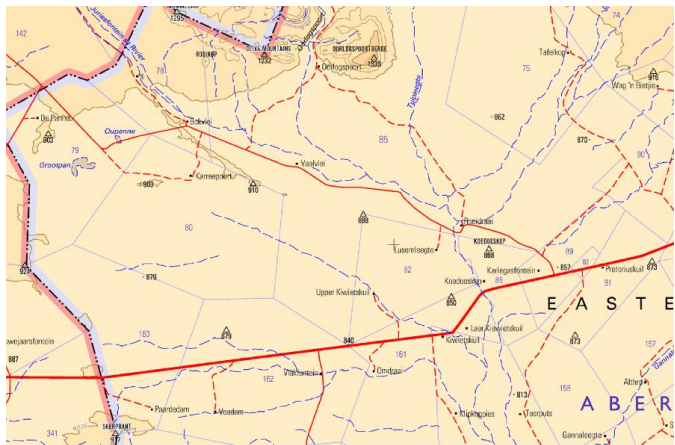


Figure 8 Ruined farm Koedoeskop relative to Alt. 2 (left).  
Farm Roodraai relative to Alt 3 (center)  
Farm Kariegafontein relative to Alternative 2 (left).



**Figure 10** Farm De Panne in relation to Alternative 1(left). Farm De Panne (right)