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PALAEONTOLOGICAL IMPACT ASSESSMENT

(Desktop Study)

PROPOSED WEST COAST ONE WIND ENERGY FACILITY

Vredenburg District, Western Cape

By

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For

Moyeng Energy (Pty) Ltd

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SUMMARY

This assessment has been prepared at the request of Savannah Environmental (Pty) Ltd. It is the part of the Heritage Impact Assessment in the EIA process being undertaken by Savannah Environmental for their client, Moyeng Energy (Pty) Ltd. The context of the assessment is the proposed construction of a wind energy facility (a wind farm), called West Coast One, on various farm portions near Vredenburg in the Vredenburg Magisterial District, Western Cape (Figure 1).

It is probable that palaeontological materials (fossils) will be uncovered in the making of excavations for the foundation of the wind turbines, the connecting cable trenches and other facilities. The National Heritage Resources Act (NHRA No. 25 of 1999) protects archaeological and palaeontological materials. Note that sampling of fossil content (palaeontological mitigation) cannot usually be done prior to the commencement of excavations. The action plans and protocols for palaeontological mitigation must therefore be included in the Environmental Management Plan (EMP) for the project.

The geological context of the area is reviewed in order to assess the nature of the expected palaeontological heritage resources. Notwithstanding, it is not possible to predict the buried fossil content of an area other than in general terms. In particular, the important fossil bone material is generally sparsely scattered in most deposits and much depends on spotting this material as it is uncovered during digging, *i.e.* by monitoring excavations.

The foundation excavations for the ~55 planned wind turbines are to be 15 by 15 m and up to 4 m deep. The proposed installations will mainly disturb Unit Q2 that mantles the entire area. However, the main areas of “fossil risk” are those underlain by a significant thickness of Q2 and older deposits (Figures 3 and 5). Within the thicker Unit Q2 are older aeolian sandsheets and deposits related to colluvial processes and drainages extending from the flanking hillslopes. Underlying Q2, the older aeolianites of the Langebaan Formation might be intersected. Pliocene marine deposits might be intersected beneath the westernmost part of the project area. Although the fossil potential is overall low, the installations involve the disturbance of a considerable volume of deposits, increasing the probability that fossils will be encountered. Buried land surfaces are present and local palaeoenvironments with enhanced potential may occur, the nature and significance of which is elaborated.

The greater part of the project area, *viz*. granite hills with a thin mantle of ploughed Q2 sandy soils, has very low fossil potential. Notwithstanding, fossils may occur in particular circumstances, such as buried crevices and small ravines that may be exposed by removal of the surface soil.

Fossils have national and international significance; examples of some significant sites exposed beneath coversands are cited. They are rare objects, particularly vertebrate fossils

(bones), which are generally preserved due to unusual circumstances. They have high scientific value. Such fossils are non-renewable resources. Provided that no subsurface disturbance occurs, the fossils remain sequestered there. Excavations into the coastal plain provide access to the hidden fossils and are potentially positive for palaeontology, <u>but only if every effort is made to watch out for and rescue the fossils</u>. Even so, there is a medium to high risk of valuable fossils being lost in spite of management actions to mitigate such loss. Machinery may destroy fossils, or they may remain be hidden in "spoil" of excavated material, or may simply be ignored. This loss of the opportunity to recover fossils and their contexts when exposed at a particular site is irreversible. The status of the potential impact for palaeontology is not neutral or negligible. Therefore, the impact (if it occurs) could be of high significance.

Summary Impact Table

<table>
<tr><td colspan="3">Nature

Construction activities (excavations) may result in a negative direct impact on the fossil content of the affected subsurface. Fossils and significant observations will be lost in the absence of management actions to mitigate such loss. This loss of the opportunity to recover them and their contexts when exposed at a particular site is irreversible.

Conversely, construction excavations furnish the "windows" into the coastal plain depository that would not otherwise exist and thereby provide access to the hidden fossils. The impact is positive for palaeontology, <u>provided that efforts are made to watch out for and rescue the fossils</u>.

There remains a medium to high risk of valuable fossils being lost in spite of management actions to mitigate such loss.</td></tr>
<tr><td><u>Impact on Fossil Resource</u></td><td>Without mitigation</td><td>With mitigation</td></tr>
<tr><td>Extent</td><td>3-5 (regional-international)</td><td>3-5 (regional-international)</td></tr>
<tr><td>Duration</td><td>5 (permanent loss)</td><td>5 (part loss, part gain, perm.)</td></tr>
<tr><td>Magnitude</td><td>10 (destruction)</td><td>6 (partly rescued)</td></tr>
<tr><td>Probability</td><td>3</td><td>3</td></tr>
<tr><td>Significance</td><td>54-60</td><td>42-48</td></tr>
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Status	Negative	Positive
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Partly
Can impacts be mitigated?	Partly	
Mitigation:	Monitoring and inspection of construction-phase excavations	

The potential impact has a moderate influence upon the proposed development, consisting of implemented mitigation measures recommended below, to be followed during the construction phase.

Both monitoring by on-site personnel and field inspections by a palaeontologist are recommended during construction of excavations.

Monitoring's purpose is intervention when bones are turned up during excavation. Fossil Finds Procedures are proposed for the appropriate responses to the discovery of paleontological materials during construction excavations when a palaeontologist is not on site.

Inspection or "Primary Fieldwork" will arise in response to finds of fossils during monitoring. The primary fieldwork phase entails the specialist documentation and sampling of pits, to establish their stratigraphic and palaeoenvironmental contexts of finds in the specific pits. Whether fossils are found or not, it is recommended that a representative selection of pits in the area be described/documented.

The greater risk to fossil material exists in the lower-lying areas. The proposed wind turbines are positioned on high ground on the flanks and tops of the hills (Figure 5). This serves to minimise the risk of encountering fossils. A more precise mitigation plan can be formulated once the installation sites are finalized.

GLOSSARY

~ (tilde): Used herein as "approximately" or "about".

Aeolian: Pertaining to the wind. Refers to erosion, transport and deposition of sedimentary particles by wind. A rock formed by the solidification of aeolian sediments is an aeolianite.

AIA: Archaeological Impact Assessment.

Alluvium: Sediments deposited by a river or other running water.

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.

asl.: above (mean) sea level.

Basement (rock): The thick foundation of ancient and oldest metamorphic and igneous rock that forms the crust of continents, often in the form of granites and gneisses.

Batholith: A large, intrusive mass of cooled magma forming a complex of related, adjacent granitic rocks.

Bedrock: Hard rock formations underlying much younger sedimentary deposits.

Calcareous: sediment, sedimentary rock, or soil type which is formed from or contains a high proportion of calcium carbonate in the form of calcite or aragonite.

Calcrete: An indurated deposit (duricrust) mainly consisting of Ca and Mg carbonates. The term includes both pedogenic types formed in the near-surface soil context and non-pedogenic or groundwater calcretes related to water tables at depth. Pedogenic types exhibit the micro-morphological features of soils, often include fossil roots (rhizoliths) and form by evapo-transpiration in semi-arid regions. Subdivisions are usually made on the basis of degree and type of cementation (*e.g*. powder, nodular, honeycomb, laminar and massive/hardpan).

Cenozoic: An Era in the Geological Time Scale. The most recent era ongoing since about 65 million years ago.

Colluvium: Hillwash deposits formed by gravity transport downhill. Includes soil creep, sheetwash, small-scale rainfall rivulets and gullying, slumping and sliding processes that move and deposit material towards the foot of the slopes.

Coversands: Aeolian blanket deposits of sandsheets and dunes.

DWAF: Department of Water Affairs and Forestry. (Now the Department of Water and Environmental Affairs (DWEA).

Early Stone Age: The archaeology of the Stone Age between 2 000 000 and 250 000 years ago.

EIA: Environmental Impact Assessment.

EMP: Environmental Management Plan.

Fluvial deposits: Sedimentary deposits consisting of material transported by, suspended in and laid down by a river or stream.

Fm.: Formation.

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).

HIA: Heritage Impact Assessment.

ka: Thousand years or kilo-annum (10^3 years). Implicitly means "ka ago" *i.e*. duration from the present, but "ago" is omitted. The "Present" refers to 1950 AD. Generally not used for durations not extending from the Present. Sometimes "kyr" is used instead.

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

Ma: Millions years, mega-annum (10^6 years). Implicitly means "Ma ago" *i.e.* duration from the present, but "ago" is omitted. The "Present" refers to 1950 AD. Generally not used for durations not extending from the Present.

Midden: A pile of debris, normally shellfish and bone that have accumulated as a result of human activity.

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

Miocene: Epoch in the Geological Time Scale, from 23-5 Ma.

National Estate: The collective heritage assets of the Nation.

Optically stimulated luminescence (OSL): One of the radiation exposure dating methods based on the measurement of trapped electronic charges that accumulate in crystalline materials as a result of low-level natural radioactivity from U, Th and K. In OSL dating of aeolian quartz and feldspar sand grains, the trapped charges are zeroed by exposure to daylight at the time of deposition. Once buried, the charges accumulate and the total radiation exposure (total dose) received by the sample is estimated by laboratory measurements. The level of radioactivity (annual doses) to which the sample grains have been exposed is measured in the field or from the separated minerals containing radioactive elements in the sample. Ages are obtained as the ratio of total dose to annual dose, where the annual dose is assumed to have been similar in the past.

Palaeontology: The study of any fossilised remains or fossil traces of animals or plants which lived in the geological past and any site which contains such fossilised remains or traces.

Palaeosol: An ancient, buried soil whose composition may reflect a climate significantly different from the climate now prevalent in the area where the soil is found. Burial reflects the subsequent environmental change.

Palaeosurface: An ancient land surface, usually buried and marked by a palaeosol, but may be exhumed by erosion (*e.g*. wind erosion/deflation) or by mining.

Peat**:** partially decomposed mass of semi-carbonized vegetation which has grown under waterlogged, anaerobic conditions, usually in bogs or swamps.

Pedogenesis/pedogenic: The process of turning sediment into soil by chemical weathering and the activity of organisms (plants growing in it, burrowing animals such as worms, the addition of humus etc).

PIA: Palaeontological Impact Assessment.

Pleistocene: Epoch , from 2.6 Ma to 11.7 ka.

Pliocene: Epoch in the Geological Time Scale, from 5.3-2.6 Ma.

Quaternary: Period in the Geological Time Scale that includes both the Pleistocene and Holocene, *i.e.* 2.6 Ma to the present.

SAHRA: South African Heritage Resources Agency.

Stone Age: The earliest technological period in human culture when tools were made of stone, wood, bone or horn. Metal was unknown.

1. INTRODUCTION

This assessment has been prepared at the request of Savannah Environmental (Pty) Ltd. It is the part of the Heritage Impact Assessment in the EIA process being undertaken by Savannah Environmental for their client, Moyeng Energy (Pty) Ltd.

The context of the assessment is the proposed construction of a wind energy facility (a wind farm), called West Coast One, on various farm portions near Vredenburg in the Vredenburg Magisterial District, Western Cape (Figure 1).

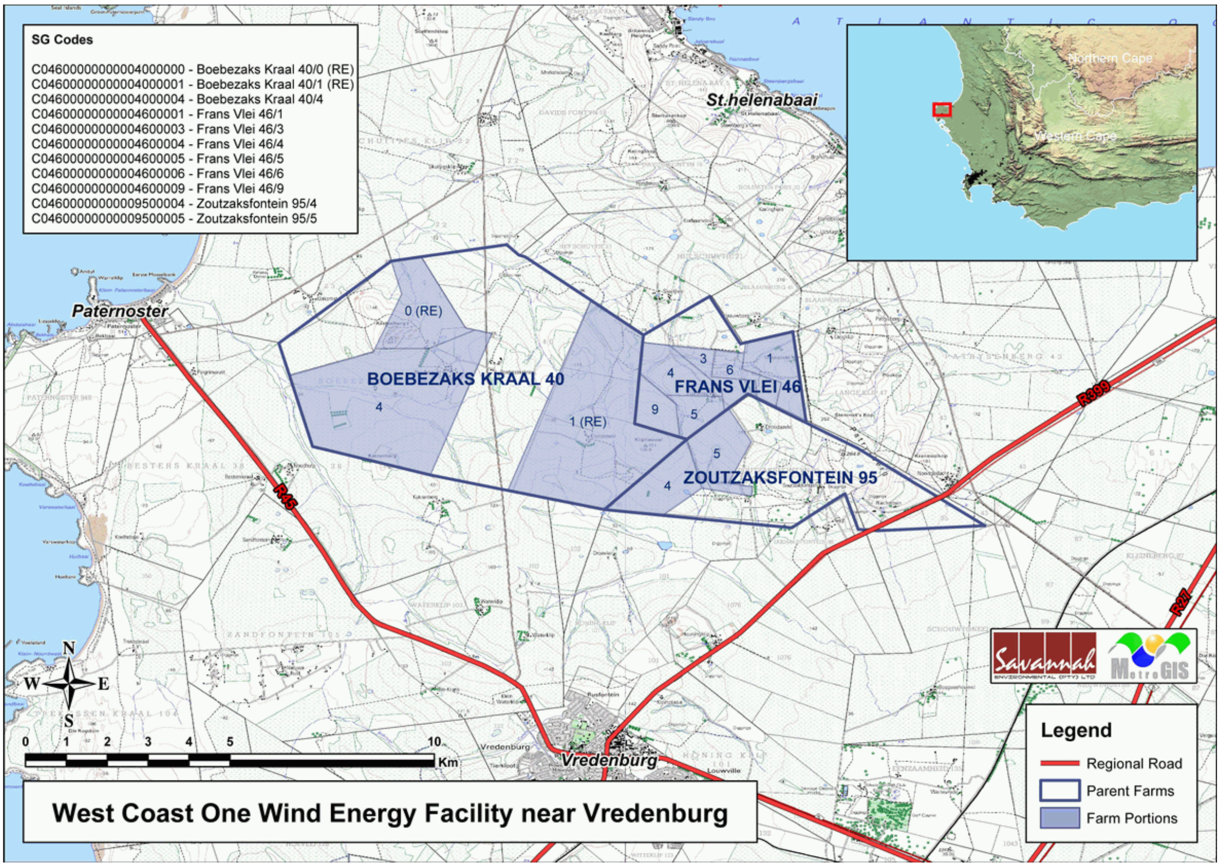

Figure 1. Locations of the farm portions for the West Coast One Wind Energy Facility proposed by Moyeng Energy (Pty) Ltd, near Vredenburg. Supplied by Savannah Environmental.

The proposed development will involve the installation of up to 55 wind turbines on concrete foundations, underground cabling to a substation and power lines to the national grid network into which the generated electricity will feed. Also involved are existing road upgrades, new access roads, temporary construction-related areas and operational facilities.

The Palaeontological Impact Assessment (PIA) assesses the probability of palaeontological materials (fossils) being uncovered in the subsurface and being disturbed or destroyed in the process of making excavations. The main purposes are to:

- Outline the nature of possible palaeontological heritage resources in the subsurface of the affected area.
- Suggest the mitigatory actions to be taken with respect to the occurrence of fossils during the construction phase.

The report proposes appropriate responses and procedures for fossil finds during the making of construction excavations when a palaeontologist is not on site.

Figure 2. Simulated oblique aerial view of the setting of the proposed West Coast One Wind Energy Facility, looking from the south. From Google Earth.

2. APPROACH AND METHODOLOGY

2.1 Available Information

The main information for the area is Visser & Schoch (1973) and the accompanying geological map, the relevant part of which is reproduced as Figure 3. Other references are cited in the normal manner and included in the References section.

2.2 Assumptions and Limitations

It is not possible to predict the buried fossil content of an area other than in general terms. In particular, the important fossil bone material is generally sparsely scattered in most deposits and much depends on spotting this material as it is uncovered during digging *i.e.* by monitoring excavations.

The premininary layout of the 55 installations has been provided by Moyeng Energy (Figure 5). The concrete foundations are to be 15X15 m slabs up to 4 m thick. This will create subsurface sections of ~60 m and ~4 m in lateral and vertical extents, respectively.

Specific details of geological sections in the area are not readily available. The most likely source of subsurface information would be water boreholes logged during investigations by the Dept. of Water Affairs, but these contain just very basic lithological information. No subsurface geotechnical investigation reports of the site are available.

3. PALAEONTOLOGICAL HERITAGE MANAGEMENT

The rescue of fossils or sampling of fossil content (palaeontological mitigation) cannot usually be done prior to the commencement of excavations for infrastructure and foundations.

Although fossils may be exposed on the surface in the vicinity of some of the sites, this material is usually disturbed and fragmentary. In most cases, such surficial or shallowly-buried material is in an archaeological context, to be dealt with by qualified archaeologists. The intent of palaeontological mitigation is to sample the *in situ* fossil content and describe the exposed, pristine stratigraphic sections. These palaeontological interventions thus happen once the EIA process is done, the required approvals have been obtained and excavation of the pits is proceeding.

The action plans and protocols for palaeontological mitigation must therefore be included in the Environmental Management Plan (EMP) for the project.

Palaeontological mitigation is a longer-term process and generally does not *a priori* impede a project. It is possible that during the course of works an exceptional occurrence could be uncovered that may require a more extended mitigation programme or perhaps conservation *in situ*. In the case of a wind farm, the latter events could be accommodated by the relocation of the tower a short distance off, or the rerouting of a trench.

4. GEOLOGICAL SETTING

4.1. Local Geology

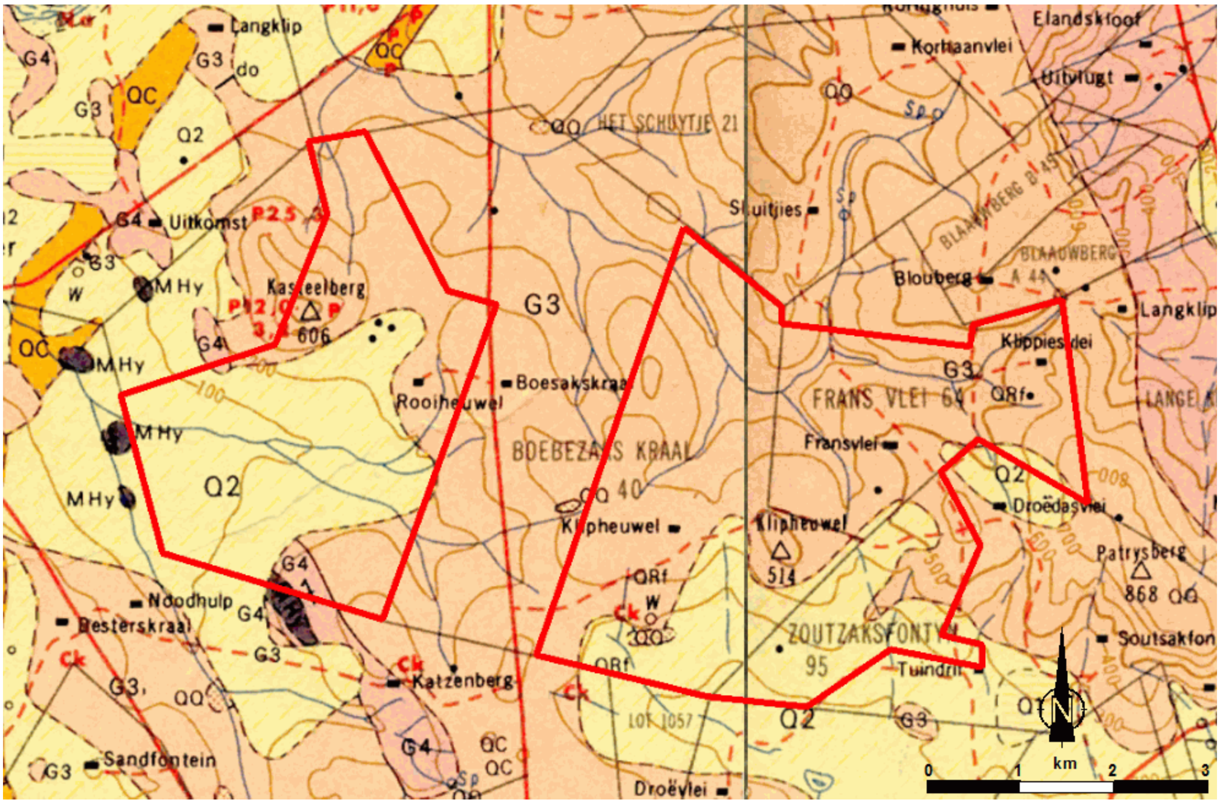

Figure 3. Geology of the project areas. From Visser & Schoch (1972), 1:125000 Map Sheet 255: 3217D & 3218C (St Helenabaai), 3317B & 3318A (Saldanhabaai). Contours 100 feet interval.

Q1: A widespread surface unit is the recent soil-unit Q1, white to slightly-reddish sandy soil, which is mainly stabilized sand sheet and locally old dunes blanketing the underlying geology.

Q2: An older surface soil-unit Q2, shallow sandy soil with heuweltjies (heuweltjiesveld), occurs inland the coast. Incipient calcretes occur in Q2. It overlies the Langebaan "Limestone" Formation.

QC: The **Langebaan "Limestone" Formation**, aeolianite Unit QC, consists of fossil dunes and sandsheets. It is underlain mainly by marine deposits of Pliocene age (Varswater & Uyekraal fms). Closer to the coast, Quaternary beach deposits are interbedded in the aeolianites.

G3 & G4: Respectively, the Vredenburg and Cape Columbine Granites.

Figure 4. Geology of the project areas, 3D overlay in Google Earth.

The West Coast One project area is situated on the high ground of the Vredenburg Peninsula and is primarily underlain by Cape Granites of the Vredenburg Batholith. These have been eroded to form gently-rounded hills, many studded on summits with rock outcrops, separated by small, ephemeral streams. The land use of the area is mainly wheat fields grown on the mostly thin soil that mantles the granite.

The western portion of the project area is dominated by Kasteelberg (185 m asl.) in its northern part. The southern part features the confluence of the minor streams draining the surrounding rising ground. Where this drainage joins the Eerste Mosselbank Rivier at the westernmost point of the area, the elevation is only ~20 m asl. Around the eastern part, the elevations of the hilltops are 80-100 m asl.

The eastern portion of the project area encompasses a row of partly-connected, progressively higher hilltops that make a local watershed, separating the streams that join to drain off northwestwards from streams that drain southwards. The hilltops rise from ~140 to ~250 m asl. eastwards. The lowest elevation of ~50 m asl. occurs where the drainage exits the area in its northwestern corner.

The oldest Cenozoic fossiliferous marine deposits found on the coastal plain are of mid-Miocene age ~16 Ma. These deposits now occur up to about 100 m asl., but are poorly preserved. In this area they have been eroded away, but not all evidence of this time when the coastal plain was so extensively submerged has been lost. The phosphate mineralization around the summit of Kasteelberg (red P values in Figure 3) dates from this time when it was an island and an offshore seabird roost covered in guano. The phosphorus leached from the guano and impregnated the underlying granite, forming a kind of “mineralogical fossil”. Similar occurrences are found on several other coastal summits in the region that were islands during the mid-Miocene submergence.

Subsequent Pliocene palaeoshoreline deposits (5-3 Ma) are found below ~50 m asl. (Pether *et al*., 2000). In the southwestern Cape, these marine deposits are collectively known as the **Varswater Formation**. For the most part, the Varswater Fm. is concealed beneath Langebaan Fm. aeolianites, but its distribution is known from boreholes. The type locality is at the West Coast Fossil Park, where the extensive vertebrate assemblage recovered from the phosphate quarry indicates an early Pliocene age (Hendey, 1981).

Towards the coast, the Varswater Formation has been eroded during a subsequent, mid-Pliocene (3.0-3.4 Ma) high sea level and is overlapped by another formation of marine sediments named the “**Uyekraal Shelly Sand**” by Rogers (1983). The Uyekraal farm near Saldanha Bay is the “type area”, but there is no type section exposed and the “Uyekraal Shelly Sand” is known there only from boreholes. At the coast, outcrops with extinct and warm-water fossil shells occur at Langebaan, Leentjiesklip, Bomgat, Sea Harvest, Elandspunt and the lower quarry at Diazville. These are the outer, eroded edge of the "Uyekraal Shelly Sand". Closer by, oyster beds at ~30 m asl. on Duyker Eiland farm above Britannia Bay are likely to be a correlate. The "Uyekraal Shelly Sand" is not yet formally recognized as a separate formation and is still included in the Varswater Formation, but should be treated as a separate formation.

In summary, during the early Pliocene the granite hills of the Vredenburg Peninsula were submerged to a level now at ~50 m asl. and were probably cut off from the mainland. When sea level later receded, fossiliferous shallow-marine deposits of the Varswater Formation were left mantling the emerged coastal plan. Sea level rose again in the middle Pliocene to a level now ~30 m asl. An isthmus, comprised mainly of previously-deposited, earlier Pliocene sediments, would have linked the Vredenburg Peninsula hills to the mainland. When sea level receded again, the Uyekraal Formation "Shelly Sands" were deposited as the shorelines prograded seawards.

The **Langebaan Formation** overlies these marine deposits and most visibly includes the ridges and mounds of old calcareous aeolianites (dune sandstones), beneath a capping calcrete crust, that are evident in the coastal landscape (Figure 3, deep yellow, QC). Previously called the "Langebaan Limestones", much of the sand is tiny fragments of shell and was blown off (deflated) from beaches. The cementing of this "calcarenite" is generally quite weak, but much denser cementing has taken place in the uppermost part of the fossil dunes in the shape of a "carapace" or capping of calcrete. The calcrete is a type of soil called a pedocrete, formed in the near-surface by evapo-transpiration after the dunes became inactive and were vegetated.

The "Langebaan Limestones" contain further calcretes and leached *terra rosa* soils at depth, attesting to reduced rates of sand accumulation, with soil formation showing the surface stability. The aeolianites overlie wind-deflation erosion surfaces formed on the underlying marine deposits, *i.e.* the Varswater and Uyekraal formations. At this stage the Langebaan Fm. includes various aeolianites of different ages and is an "amalgam" of the dune plumes that formed on the coastal plain, at differing places and times, mainly during the last ~5 Ma (Pliocene to the late Pleistocene). This is reflected in the different ages indicated from fossils found at various places. For example, a late Pliocene or younger age (Diazville lower quarry, Roberts & Brink, 2002), early Pleistocene (Skurwerug, Hendey & Cooke, 1985), middle and late Pleistocene ages are indicated by relationships to Last Interglacial (~125 ka) and earlier shoreline deposits and by dating of aeolianites by luminescence methods (Roberts *et al.*, 2009).

Some aeolianite accumulations could be distinctly older. For instance, the aeolianite ridge stretching north from Saldanha Bay up the coast to near Paternoster has been found to have fossil eggshell fragments of extinct ostriches (*Diamantornis wardi*) and extinct land snail forms (Roberts & Brink, 2002). *Diamantornis wardi* is dated as mid-Miocene (10-12 Ma) in the Namib Desert (Senut & Pickford, 1995). These aeolianites, previously considered to belong to the Langebaan Formation, are now called the **Prospect Hill Formation** (Figure 4) due to the significantly older age indicated by the fossils (Roberts & Brink, 2002). However, the matter is not clear cut as sand-size marine microfossil species, blown from the ancient beaches of the time, suggest that the dunes formed by deflation of younger Pliocene deposits (Dale & McMillan, 1999).

None of the aforementioned formations crop out in the project area. The marine formations are buried, but the Langebaan Formation aeolianites crop out close by (Figure 3, QC). The northern end of the Miocene Prospect Hill Formation aeolianites is also nearby on Besterskraal. However, in the project area the coversand **Unit Q2** (Figure 3) has been deposited over all older formations, including most of the granite hills.

Unit Q2 is characterized by its surface manifestation as the distinct "heuweltjiesveld", the densely dot-patterned landscape of low hillocks that are termitaria made by *Microhodotermes viator*. These are longed-lived features that are persistently inhabited by generations of termites. The "heuweltjies" occur in a background of light reddish-brown, sandy soil, but they have internal calcretes due to enrichment in calcium by the plant-gathering activity of the termites. Radiocarbon dating by of the calcrete in an actively inhabited example near Clanwilliam suggests that it had been in existence for at least 4000 years (Moore & Picker, 1991). Notwithstanding, it seems that over large areas the termitaria are inactive and are now "fossil" features in the landscape.

The dot-patterned "heuweltjiesveld" is merely the surface-soil characteristic of Unit Q2. On the granite hills Unit Q2 is just a soil mantle and so is ignored for the purposes of geological mapping (Figure 3); it is mapped where there is an underlying thickness of deposits post-dating the Langebaan "Limestone" aeolianites. Unit Q2 underlies a large part of the lower ground in the western project area and occurs mainly on the southern slopes of the eastern project area (Figures 3 & 4).

Not much detail is known about Unit Q2 at depth (sub-Q2). Pedogenic layers of ferruginous concretions, clayey beds and minor calcretes occur among sandy-soil beds. Clearly Q2 will differ from place to place according to the local setting. In this area, in addition to windblown sands from the south, Q2 will likely comprise the local colluvial/hillwash/ sheetwash deposits, small slope-stream deposits, alluvium in the lower valleys and wind-reworked local alluvial and colluvial sands.

Surface **Unit Q1** is the youngest geological unit and is "white to slightly-reddish sandy soil" (Visser & Toerien, 1971; Visser & Schoch, 1973). These are patches of pale sand deposited in geologically-recent times. In places these sands are undergoing semi-active transport and locally have been remobilized into active sandsheets and dunes. Visser & Schoch

(1973) consider the sands to be largely derived from older, underlying Q2 sands and to a lesser extent from the erosion of bedrock, the coastal dunes and the alluvial deposits of past and present drainage systems. Patches of Q1 do not occur in the project areas, the closest being a patch just outside, accumulated below the steeper Patrysberg slopes near the Soutsakfontein homestead. Q1 sands also cover the area just inland of the coast along Paternosterbaai.

Chase & Thomas (2007) have cored Q1 sands and applied optically stimulated luminescence (OSL) dating techniques to establish the timing of sand accumulation. Their results indicate several periods of deposition of Q1 during the last 100 ka, with activity/deposition at 4–5, 16–24, 30–33, 43–49 and 63–73 ka. Underlying sands produced dates from ~150 to ~300 ka, evidently reflecting the accumulation of Unit Q2.

4.2. Expected Palaeontology

In the south-western extreme of the western project area, at the lowest elevations, 4 m deep excavations may just encounter erosional remnants of fossiliferous Pliocene marine sediments (For example, at depth below Site 55, Figure 5). However, the likelihood is low .due to burial under the younger formations.

In the same vicinity, more probable is the presence of Langebaan Formation aeolianite at depth, or perhaps even older aeolianite of the Prospect Hill Formation (Figure 5, sites 40, 52, 54, 55). Buried Langebaan Fm. may also occur beneath the sub-Q2 deposits in the lower parts in the south of the eastern project area. However, the turbine sites (10, 11, 12) are higher up on the slopes, where this is less likely (Figure 5).

The Langebaan Fm. aeolianites do not appear to be very fossiliferous to the cursory eye, but fossils from this formation and its correlates have been a prime source of information on Quaternary faunas and archaeology. Most of the fossils in the aeolianites are associated with particular contexts (see below).

Unit Q2 will be intersected everywhere on the development site. On the granite hills, where most of the installations are proposed to be, the foundation excavations will in most cases fully penetrate thin Q2 soil to the granite bedrock. Presumably the latter will be excavated to “refusal”, *i.e.* solid, unweathered bedrock. The overall potential for fossils in the disturbed soil mantle is very low. Notwithstanding, the excavations may expose buried crevices and “gullies” in the granite slopes where the potential for fossil finds is locally high. These may be associated with deposits of seeps and small vleis at the headwaters of drainages.

Where Q2 thickens downslope off the granite hills, the initial subsurface Q2 unit is expected to be dominated by hillwash, while at lower levels the alluvial deposits of small fluvial systems will feature and both types will interfinger with the aeolian deposits. Again, the fossil potential is overall low.

In the lower reaches of the local drainages it is possible that the deposits of vleis might also occur, formed for instance due to blocking of the drainage by migrating dune sands. These have high fossil potential. However, the proposed sites avoid these areas.

The proposed installations will mainly disturb Unit Q2 that mantles the entire area, older aeolian sandsheets beneath Q2 and deposits related to colluvial processes and drainages extending from the flanking hillslopes. Underlying Q2 the older aeolianites of the Langebaan Formation might be intersected. Most of the deposits to be encountered are aeolian in origin.

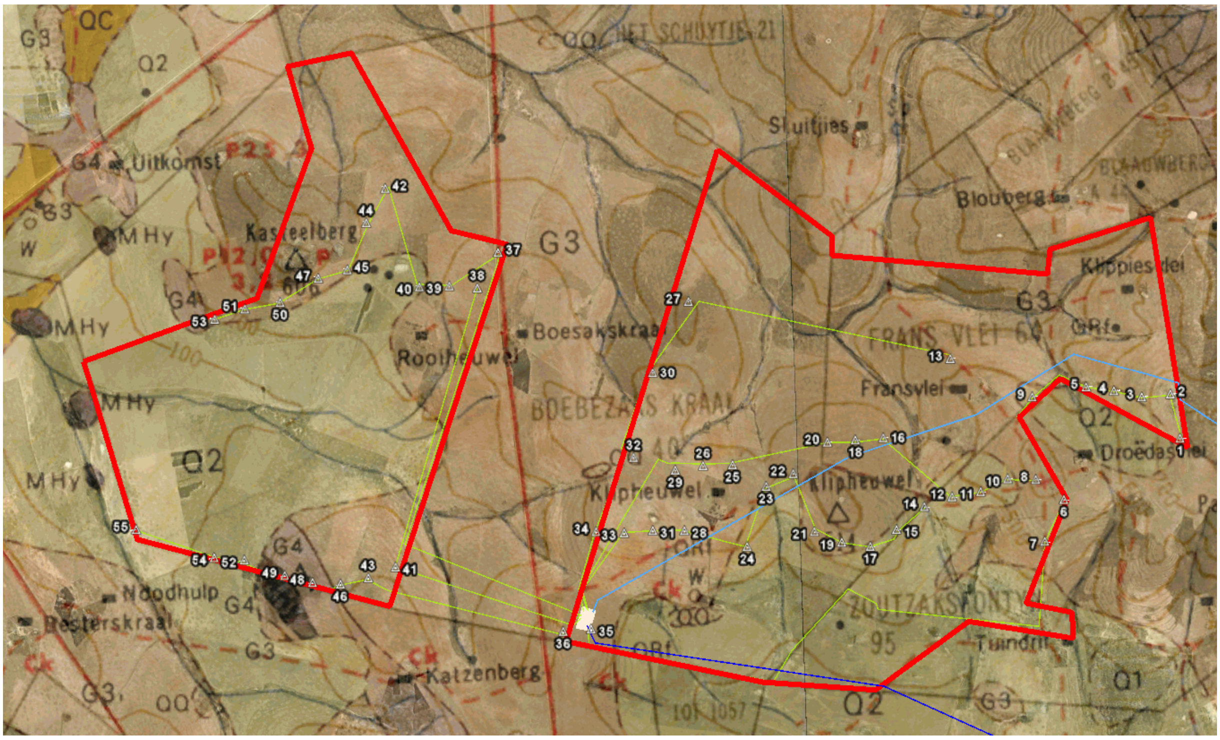

Figure 5. Proposed locations of the 55 wind turbines.

4.2.1. Fossils in aeolian settings

Not unexpectedly, the most common fossils in dunes and sandsheets are land snail shells, tortoise shells/bones and the bones of moles. Less easily seen, but obtainable by sieving, are the bones of rodents, small birds and reptiles. These fossils may occur anywhere, but are scarce within the main bulk of dune and coversands. Fossils are more common on old buried surfaces, called palaeo-surfaces, that separate periods of sand accumulation, when the surface was stabilized and colonized by vegetation and animals. The causes of diminished sand supply are inter-related factors of climate change, such as changes in windiness, rainfall and sand availability. Palaeosurfaces are marked by various degrees of soil formation. The main palaeosurfaces are those within sub-Q2, between Q2 and the Langebaan aeolianite, and within the latter.

Fossil bones of larger animals (antelopes, ostriches, jackals, porcupines) usually occur very sparsely on palaeosurfaces over a broad area. In many cases these appear to be isolated finds, but what appears to be a single bone may lead to further finds at the spot, such as a scatter of bones accumulated by hyaenas, which may include quite a variety of animals. Hyaena bone concentrations are also found in the holes made by aardvarks, which the hyaena has taken over to use as a lair. In cemented aeolianites, the calcretes have facilitated overhangs or roofs for hollows or small caves formed by the crumbling of the softer material beneath. These are used as lairs by hyaenas and other predators/ scavengers, superimposing younger bone concentrations into an older, partly-cemented aeolianite.

Although fossils in aeolian accumulations are more common in association with longer-lived, more-stable surfaces, the best concentrations of fossils are formed where the wind scours away and removes previously-deposited sand, producing a scoop-shaped palaeosurface called a “blowout”. The fossils that were sporadically distributed within the sands are then concentrated on the bottom of the “deflation” blowout. A concentration of snail shells is a clue indicating that a closer look may be worthwhile.

This erosional scenario can be extended to larger areas in which sand is moving through on the long term, in the form of migrating dunes at various scales. At any one time there are numerous blowout areas between migrating sand forms. Objects on or within the migrating sand end up on the stable surface across which the sand is moving. This basal surface could be a compact, semi-consolidated soil palaeosurface capping previously-deposited sands. It may also be a surface controlled by the water table, where the damp/wet sand is prevented from being blown away. These sorts of “floors” or “omission surfaces” are an absolute must as a target for fossil hunting and rescue.

Large hollow areas created by wind erosion blowout may subsequently become a pond of standing water, due to increased rainfall, lack of a drainage outlet and rising local water table. This occurs on a variety of scales, from a mere small boggy area, an ephemeral pan, to vleis of longer duration.

4.2.2. Fossils in vleis

Vleis occur where groundwater seepage surfaces and these preserve a great variety of fossil material. As local sources of water, they attract the larger herbivores from the surrounding area, their predators and scavengers and thus become a spot where fossils occur. There is the fossil record of the pond/vlei life itself, a lot of which also turns up rather mysteriously, like the frogs, aquatic snails and small fish. The best bet is for their eggs being inadvertently brought in by birds, a sample of which is also entombed.

Microfossils include the ostracods (microscopic crustaceans with often very specific requirements) and the diatoms (minute plants with glass shells). More locally, reeds, leaves, fruiting bodies and root masses are preserved in the muds. Ancient ponds and vleis, as natural traps of windborne material, also provide a glimpse of the greater, surrounding vegetation, in the form of pollen capsules from near and far, and windborne charcoal fragments from fires, usually of fairly close origin.

4.2.3. Fossils in watercourses

The drainages descending the flanks of the adjacent hills currently deposit minor alluvium on the plain below. These drainages must have been more active in the past during periods of wetter climate. Very likely there are deposits of these small-scale fluvial systems beneath Q2 coversand/soil. The fossil potential is low, such as abraded bone fragments and loose teeth occurring sparsely in channel lags. However, associated seeps and vleis have good fossil potential, as outlined above.

4.2.4. Buried archaeological material

Ancestral South Africans were around during the times of formation of units Q1 and Q2, as well as the younger parts of the Langebaan Fm. Thus it is perfectly possible that some of the bones found in the sands may be associated with past human activities. This is indicated by the co-occurrence of mussel and limpet shells, stone tools, pottery and charcoal from cooking hearths. Archaeological material and bones are often exposed where blowouts have formed, due to loss of vegetation and disturbance. Middle Stone Age implements and associated fossil bone are found on the upper part of Unit Q2.

5. APPLICABLE LEGISLATION

The National Heritage Resources Act (NHRA No. 25 of 1999) protects archaeological and palaeontological sites and materials, as well as graves/cemeteries, battlefield sites and buildings, structures and features over 60 years old. The South African Heritage Resources Agency (SAHRA) administers this legislation nationally, with Heritage Resources Agencies acting at provincial level.

According to the Act (Sect. 35), it is an offence to destroy, damage, excavate, alter of remove from its original place, or collect, any archaeological, palaeontological and historical material or object, without a permit issued by the South African Heritage Resources Agency (SAHRA) or applicable Provincial Heritage Resources Agency, *viz*. Heritage Western Cape (HWC).

Notification of SAHRA or the applicable Provincial Heritage Resources Agency is required for proposed developments exceeding certain dimensions (Sect. 38).

6. THRESHOLDS

The areal scale of subsurface disturbance and exposure exceeds 300 m in linear length and 5000 m^2 (NHRA 25 (1999), Section 38 (1)). It must therefore be assessed for heritage impacts (an HIA) that includes assessment of potential palaeontological heritage (a PIA).

For the evaluation of the palaeontological impact it is the extent/scale of the deeper excavations to be made that are the main concern, mainly the foundations for the wind towers, the trenches for connecting cabling and foundation trenches for buildings, latrine pits, dump pits etc.

The wind turbine foundations are square concrete platforms with sides of 15 m in length, sunk about 4 m below ground level. These large excavations are very likely to uncover fossil and archaeological material, particularly as there will be a considerable number of them (55) positioned over and “sampling” a wide area. Each finished excavation of these maximum dimensions exposes 465m^2 of subsurface section in its sides and bottom. Much more section is exposed incrementally during the digging of the excavation. For instance, even with partial exposure, well in excess of 1000 m^2 could be temporarily exposed. Thus, in spite of the overall low fossil potential, there is a definite probability that fossils may be exposed.

The cabling trenches, although probably quite narrow and shallow (~1.0 m deep ?), are likely to be of considerable length in crossing the area to the substation. This increases the likelihood of fossil and archaeological material being uncovered. The footings of the transmission line pylons that connect to the grid are likely to be minor in scale and have the least likelihood of fossil finds, although not altogether absent.

7. SIGNIFICANCE

In spite of the scientific attention the area has received, most observations and recovered fossils pertain to the West Coast Fossil Park exposures at the old phosphate mine and to strata exposed along the present coast. Comparatively little is known of the wider Saldanha-area coastal plain due to the lack of natural exposures. Practically every excavation made in the past has yielded fossils, but palaeontological mitigation requirements were not always in place and “windows of opportunity” were lost.

Fossil finds in this context stand to have heritage/scientific benefits in increasing the knowledge of the coversands of the coastal plain. The various periods during which the coversand formations (units Q1 and Q2) and the underlying formations (older aeolian sands) were deposited in different areas are not well-constrained by fossil evidence, as very few fossils have been collected/rescued. Only recently has a modern dating method (OSL) been applied at a few localities (Chase & Thomas, 2007; Roberts *et al*., 2009). The coastal plain deposits of the West Coast One area are very poorly known.

Past discoveries show that the fossil potential within and beneath coversands and dunes can be very significant. The most well-studied is Elandsfontein, where blowouts of the coversand exposed thousands of underlying fossil bones and Stone Age tools, the occurrence of which is associated with a fossil vlei formed due to higher water tables in the past (Klein *et al*., 2007). Notably, prior to the wind erosion of coversands at Elandsfontein, there would have been no indication of the fossil wealth just below. At Geelbek Dunefield the deflation hollows located between the wind-blown, actively-mobile sand dunes are a source of mammalian fossils and Stone Age tools, with more being constantly exposed (Kandel *et al*., 2003). An example of fossiliferous deposits in a small-scale fluvial setting, beneath Q2 sands, are those of the old Baard's Quarry near Langebaanweg Station, where the first finds of fossils from that now-famous Langebaanweg locality were made (Tankard, 1974; Hendey, 1978). All these fossil localities have attracted international attention.

Although the 4 m deep excavations involved in the installations are of limited depth *cf*. mine quarries and the fossil potential is low overall, the number of excavations involved increases the probability of fossils being turned up. Mitigation during the construction phase of the proposed project has the potential for further discoveries that stand to have heritage/scientific benefits.

In summary, the significance of fossils that may be found involves:

- Significance in the history of coastal-plain evolution.
- Significance for the history of past climatic changes.
- Significance in the history of past biota and environments. Rescuing of fossil bones is very important. These may not necessarily represent species that we would expect nowadays. Modern analytical techniques such as stable isotopic analyses can reveal indications of diets and environmental conditions of the past.
- Associations of fossils with buried archaeological material and human prehistory.
- For radiometric and other dating techniques (rates of coastal change).
- Preservation of materials for the application of yet unforeseen investigative techniques.

There is a significance to fossils beyond their conventional academic/scientific importance that is more firmly in the realm of cultural aesthetics. Culture is embedded in land/place/ animals and fossils are part of the physical strata of the landscape. Fossils inform the appreciation of the space-time depth of landscape and its biota, living and extinct. Such realizations are inspired by encounters with fossils. Ultimately this heritage resource must be rendered known and accessible to the wider community *via* educational programmes emanating from *e.g*. museums, sponsorship, NGOs. The first priority, however, is to rescue fossils and attendant information that would otherwise be lost.

There is a potential positive socio-economic impact to a significant find of fossils. This may be minor and short-term, *e.g*. the local spending involved in labour and supplies for the fieldwork to excavate the find. It may bring long-term benefits, such as the establishment of a local museum and tourist attraction. Corporate involvement in sponsorship of such initiatives is demonstrative of social responsibility.

8. NATURE OF THE IMPACT OF DEVELOPMENT EXCAVATIONS ON FOSSILS

Fossils are rare objects, often preserved due to unusual circumstances. This is particularly applicable to vertebrate fossils (bones), which tend to be sporadically preserved and have high value w.r.t. palaeoecological and biostratigraphic (dating) information. Such fossils are non-renewable resources. Provided that no subsurface disturbance occurs, the fossils remain sequestered there.

When excavations are made they furnish the “windows” into the coastal plain depository that would not otherwise exist and thereby provide access to the hidden fossils. The impact is positive for palaeontology, <u>provided that efforts are made to watch out for and rescue the fossils</u>. Fossils and significant observations will be lost in the absence of management actions to mitigate such loss. This loss of the opportunity to recover them and their contexts when exposed at a particular site is irreversible.

The status of the potential impact for palaeontology is not neutral or negligible.

Although coastal coversands are not generally very fossiliferous, it is quite possible that fossiliferous material could occur. The very scarcity of fossils makes for the added importance of them being sought.

There remains a medium to high risk of valuable fossils being lost in spite of management actions to mitigate such loss. Machinery involved in excavation may damage or destroy fossils, or they may be hidden in “spoil” of excavated material. Worse, they may simply be ignored as “Just another bone”.

9. IMPACT ASSESSMENT

9.1. Nature of the Impact

9.1.1. Extents

The physical extent of impacts on potential palaeontological resources relates directly to the extents of subsurface disturbance during construction.

The cultural, heritage and scientific impacts are of regional to national extent, as is implicit in the NHRA 25 (1999) legislation and, if scientifically important specimens or assemblages are uncovered, are of international interest. This is evident in the amount of foreign-funded research that takes place by scientists of other nationalities. Loss of opportunities that may arise from a significant fossil occurrence (tourism, employment) filters down to regional/local levels.

9.1.2. Duration

According with the above, the physical duration of the impact is shorter term (< year) and primarily related to the period over which foundations, trenches and other infrastructural excavations are made. This is the "time window" for mitigation.

Again, the impact of both the finding or the loss of fossils is permanent. The found fossils must be preserved "for posterity"; the lost, overlooked or destroyed fossils are lost to posterity.

9.1.3. Magnitude

Thus the potential impact of construction on fossil resources is high in the absence of mitigation. As mentioned, it is quite likely that scientifically valuable fossils may be lost in spite of mitigation.

9.1.4. Probability

The likelihood of impact is probable and likely to occur under most conditions in this context, *i.e.* it is medium.

9.1.5. Confidence

The level of confidence of the probability and intensity of impact is medium to high.

9.2. Summary table

Nature		
Construction activities (excavations) will result in a negative direct impact on the probable fossil content of the affected subsurface. Fossils and significant observations will be lost in the absence of management actions to mitigate such loss. This loss of the opportunity to recover them and their contexts when exposed at a particular site is irreversible. Conversely, construction excavations furnish the "windows" into the coastal plain depository that would not otherwise exist and thereby provide access to the hidden fossils. The impact is positive for palaeontology, provided that efforts are made to watch out for and rescue the fossils. There remains a medium to high risk of valuable fossils being lost in spite of management actions to mitigate such loss.		
Impact on Fossil Resource	**Without mitigation**	**With mitigation**
Extent	3-5 (regional-international)	3-5 (regional-international)
Duration	5 (permanent loss)	5 (part loss, part gain, perm.)
Magnitude	10 (destruction)	6 (partly rescued)
Probability	3	3
Significance	54-60	42-48
Status	Negative	Positive
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Partly
Can impacts be mitigated?	Partly	
Mitigation:	Monitoring and inspection of construction-phase excavations	

10. RECOMMENDATIONS

The potential impact has a moderate influence upon the proposed development, consisting of implemented mitigation measures recommended below, to be followed during the construction phase.

Monitoring by on-site personnel and field inspections by a palaeontologist are recommended during construction of excavations.

10.1. Monitoring

OBJECTIVE: To see and rescue fossil material that may be exposed in the various excavations made for installation foundations and cabling.		
Project components	Foundation excavations for wind turbines. Foundation excavations for substations. Trenches for cabling linking turbines and substations. Spoil from excavations.	
Potential impact	Loss of fossils by their being unnoticed and/ or destroyed.	
Activity/ risk source	All bulk earthworks.	
Mitigation: target/ objective	To facilitate the likelihood of noticing fossils and ensure appropriate actions in terms of the relevant legislation.	
Mitigation: Action/ control	**Responsibility**	**Timeframe**
Inform staff of the need to watch for potential fossil occurrences.	Moyeng, Savannah, ECO, contractors.	Pre-construction.
Inform staff of the procedures to be followed in the event of fossil	ECO/specialist.	Pre-construction.

occurrences.		
Monitor for presence of fossils	Contracted personnel and ECO.	Construction.
Liaise on nature of potential finds and appropriate responses.	ECO and specialist.	Construction.
Inspect main finds and selected, higher-risk excavations	Specialist.	Construction.
Obtain permit from HWC for finds.	Specialist.	Construction
Performance Indicator	Reporting of and liaison about possible fossil finds. Fossils noticed and rescued.	
Monitoring	Due effort to meet the requirements of the monitoring procedures.	

As outlined above, the potential for finding important fossils, although low, is not altogether lacking. Interventions are particularly required if bones are turned up during excavation. These are rare and valuable and every effort should be made to spot them and effect rescue of them.

Below are proposed procedures in the event of discovery of fossil material. They are of a general nature, to be adapted according to feasibility w.r.t. the logistics and personnel.

It is quite likely that a continuous monitoring presence over the period during which excavations are made, by either an archaeologist or palaeontologist, will not be practical. It is therefore proposed that personnel involved in the making of excavations keep a lookout for fossil material during digging.

To this end, responsible persons must be designated. This will include hierarchically:

- The field supervisor/foreman, who is going to be most often in the field.

- The Environmental Control Officer (ECO) for the project.
- The Project Manager.

The field supervisor/foreman and workers involved in digging excavations must be informed of the need to watch for fossil bones and buried potential archaeological material. Workers seeing potential objects are to report to the field supervisor who, in turn, will report to the ECO. The ECO will inform the archaeologist and/or palaeontologist contracted to be on standby in the case of fossil finds.

Should the monitoring of the excavations be a stipulation in the Archaeo-logical Impact Assessment, the contracted Monitoring Archaeologist (MA) can also monitor for the presence of fossils and make a field assessment of any material brought to attention. The MA is usually sufficiently informed to identify fossil material and this avoids additional monitoring by a palaeontologist. In shallow coastal excavations, the fossils encountered are usually in an archaeological context.

The MA then becomes the responsible field person and fulfils the role of liaison with the palaeontologist and coordinates with Moyeng Energy and the Environmental Control Officer (ECO). If fossils are exposed in non-archaeological contexts, the palaeontologist should be summoned to document and sample/collect them.

It may prove more feasible to have a dedicated monitor for exposed archaeological and palaeontological material in the numerous excavations, such person to be trained and supplied with the requisites.

10.2. Fossil Find Procedures

In the context of the sites under consideration, it is improbable that fossil finds will require declarations of permanent “no go” zones. At most a temporary pause in activity at a limited locale may be required. The strategy is to rescue the material as quickly as possible.

The procedures suggested below are couched in terms of finds of fossil bones. However, they may also serve as a guideline for the other fossil material that may occur (see ***10.2.5*** below). Bone finds can be classified as two types: isolated bone finds and bone cluster finds.

10.2.1. Isolated Bone Finds

In the process of digging the excavations, isolated bones may be spotted in the hole sides or bottom, or as they appear on the spoil heap. By this is meant bones that occur singly, in different parts of the excavation. If the number of distinct bones exceeds 6 pieces, the finds must be treated as a bone cluster (below).

Bones may also be spotted when excavated material is spread out to make roads and lay-down areas/pads.

Response by personnel in the event of isolated bone finds

- **Action 1:** An isolated bone exposed in an excavation or spoil heap must be retrieved before it is covered by further spoil from the excavation and set aside.
- **Action 2:** The site foreman and ECO must be informed.
- **Action 3:** The responsible field person (site foreman or ECO) must take custody of the fossil. The following information to be recorded:
    - Position (excavation position).
    - Depth of find in hole.
    - Digital image of hole showing vertical section (side).
    - Digital image of fossil.
- The fossil should be placed in a bag (*e.g.* a Ziplock bag), along with any detached fragments. A label must be included with the date of the find, position info., depth.
- **Action 4:** ECO to inform Moyeng Energy, Moyeng Energy contacts the standby archaeologist and/or palaeontologist. ECO to describe the occurrence and provide images asap. by email.

Response by Palaeontologist in the event of isolated bone finds

The palaeontologist will assess the information and liaise with Moyeng Energy and the ECO and a suitable response will be established.

10.2.2. Bone Cluster Finds

A bone cluster is a major find of bones, *i.e*. several bones in close proximity or bones resembling part of a skeleton. These bones will likely be seen in broken sections of the sides of the hole and as bones appearing in the bottom of the hole and on the spoil heap, or when excavated material is spread out to make roads and lay-down areas/pads.

Response by personnel in the event of a bone cluster find

- **Action 1:** Immediately stop excavation in the vicinity of the potential material. Mark (flag) the position and also spoil that may contain fossils.

- **Action 2:** Inform the site foreman and the ECO.

- **Action 3:** ECO to inform Moyeng Energy, Moyeng Energy contacts the standby archaeologist and/or palaeontologist. ECO to describe the occurrence and provide images asap. by email.

Response by Palaeontologist in the event of a bone cluster find

The palaeontologist will assess the information and liaise with Moyeng Energy and the ECO and a suitable response will be established. It is likely that a Field Assessment by the palaeontologist will be carried out asap.

It will probably be feasible to "leapfrog" the find and continue the excavation farther along, or proceed to the next excavation, so that the work schedule is minimally disrupted. The response time/scheduling of the Field Assessment is to be decided in consultation with developer/owner and the environmental consultant.

The field assessment could have the following outcomes:

- If a human burial, the appropriate authority is to be contacted (see AIA). The find must be evaluated by a human burial specialist to decide if Rescue Excavation is feasible, or if it is a Major Find.

- If the fossils are in an archaeological context, an archaeologist must be contacted to evaluate the site and decide if Rescue Excavation is feasible, or if it is a Major Find.

- If the fossils are in an palaeontological context, the palaeontologist must evaluate the site and decide if Rescue Excavation is feasible, or if it is a Major Find.

10.2.3. Rescue Excavation

Rescue Excavation refers to the removal of the material from the just the "design" excavation. This would apply if the amount or significance of the exposed material appears to be relatively circumscribed and it is feasible to remove it without compromising contextual data. The time span for Rescue Excavation should be reasonably rapid to avoid any or undue delays, *e.g*. 1-3 days and definitely less than 1 week.

In principle, the strategy during mitigation is to "rescue" the fossil material as quickly as possible. The strategy to be adopted depends on the nature of the occurrence, particularly the density of the fossils. The methods of collection would depend on the preservation or fragility of the fossils and whether in loose or in lithified sediment. These could include:

- On-site selection and sieving in the case of robust material in sand.

- Fragile material in loose/crumbly sediment would be encased in blocks using Plaster-of Paris or reinforced mortar.

If the fossil occurrence is dense and is assessed to be a "Major Find", then carefully controlled excavation is required.

10.2.4. Major Finds

A Major Find is the occurrence of material that, by virtue of quantity, importance and time constraints, cannot be feasibly rescued without compromise of detailed material recovery and contextual observations.

A Major Find is not expected.

Management Options for Major Finds

In consultation with developer/owner and the environmental consultant, the following options should be considered when deciding on how to proceed in the event of a Major Find.

Option 1: Avoidance

Avoidance of the major find through project redesign or relocation. This ensures minimal impact to the site and is the preferred option from a heritage resource management perspective. When feasible, it can also be the least expensive option from a construction perspective.

The find site will require site protection measures, such as erecting fencing or barricades. Alternatively, the exposed finds can be stabilized and the site refilled or capped. The latter is preferred if excavation of the find will be delayed substantially or indefinitely. Appropriate protection measures should be identified on a site-specific basis and in wider consultation with the heritage and scientific communities.

This option is preferred as it will allow the later excavation of the finds with due scientific care and diligence.

Option 2: Emergency Excavation

Emergency excavation refers to the "no option" situation wherein avoidance is not feasible due to design, financial and time constraints. It can delay construction and emergency excavation itself will take place under tight time constraints, with the potential for irrevocable compromise of scientific quality. It could involve the removal of a large, disturbed sample by excavator and conveying this by truck from the immediate site to a suitable place for "stockpiling". This material could then be processed later.

Consequently, emergency excavation is not a preferred option for a Major Find.

10.2.5. Other Fossil Occurrences

Occurrences of snails

Land snails are usually quite common and usually can be seen on the sides of the excavations, although they might be widely scattered. In which case they can be left for sampling by the palaeontologist during the Inspection/Primary Fieldwork phase. Extinct species and forms of land snails have been recognized from various formations. Many snails are quite specific to particular environments. Aquatic snails occur in the deposits of vleis and watercourses and should occur in distinct beds.

If fossil snails are very sparse they should be captured. Proceed as for “Isolated Bone Finds”.

Occurrences of buried layers or lenses of marine shells

A buried archaeological site or midden. Proceed as for “Bone Cluster Finds”.

Occurrences of buried Stone Age artefacts

A buried archaeological site. Proceed as for “Bone Cluster Finds”.

Occurrences of buried logs, peats or coal-like material.

Could be a stream channel or vlei deposit. Proceed as for “Bone Cluster Finds”.

10.3. Inspection

Inspection or “Primary Fieldwork” will arise in response to finds of fossils during monitoring. The primary fieldwork phase entails the specialist documentation and sampling of pits, to establish their stratigraphic and palaeoenvironmental contexts of finds in the specific pits.

Notwithstanding whether fossils are found or not, it is recommended that a representative selection of pits in the area be described/documented.

When a set of excavations are completed:

- The excavation faces must be inspected in detail for less obvious fossil content and representative samples of fossils must be collected.
- The fossiliferous sections and other key vertical sections representative of the exposures must be systematically measured, described in detail sedimentologically (logged), duly photographed at various appropriate scales and the sediments

sampled, including apparently “barren” units. The latter may contain microfossils and lithological components of relevance.

For best cost-effectiveness, this activity should coincide with times of maximum exposure, when a large number of open pits are available. Timing is to be decided in consultation with developer/owner and the environmental consultant.

11. COMMUNICATION

11.1. Moyeng Energy (Pty) Ltd

ECO: To be provided once confirmed.

Site Foreman: To be provided once confirmed.

Project Manager: To be provided once confirmed.

11.2. Savannah Environmental (Pty) Ltd

Environmental Consultant: Ravisha Ajodhapersadh
Tel: +2711 234-6621. Fax: +2786 684 0547
Cell: 084 300 0660
PO Box 148
Sunninghill, 2157

11.3. Archaeology

Archaeology Contracts Office, Dept. Archaeology, University of Cape Town

Monitoring/responsible archaeologist: To be provided.

Tel (021) 650 2357. Fax (021) 650 2352

11.4. Palaeontology

John Pether: 083 744 6295, 021 783 3023

jpether@iafrica.com

Alternates

West Coast Fossil Park. Pippa Haarhoff: 083 289 6902, 022 766 1606.

pippah@iafrica.com

Iziko Museums of Cape Town: SA Museum, 021 481 3800.

Dr Graham Avery. 021 481 3895, 083 441 0028.

Dr Deano Stynder. 021 481 3894.

12. FOSSIL FINDS: ADDITIONAL NOTES

12.1. Application for a Palaeontological Permit

A permit from Heritage Western Cape (HWC) is required to excavate fossils. The applicant should be the qualified specialist responsible for assessment, collection and reporting (palaeontologist).

However, as the probability of fossil finds is low, a permit has not been applied for prior to the making of excavations. Should fossils be found, application for a retrospective palaeontological permit will be made to HWC immediately.

The application requires details of the registered owners of the sites, their permission and a site-plan map.

All samples of fossils must be deposited at a SAHRA-approved institution.

12.2. Reporting

Should fossils be found a detailed report on the occurrence/s must be submitted. This report is in the public domain and copies of the report must be deposited at the IZIKO S.A. Museum and Heritage Resources Western Cape. It must fulfil the reporting standards and data requirements of these bodies.

The report will be in standard scientific format, basically:

- A summary/abstract.
- Introduction.
- Previous work/context.
- Observations (incl. graphic sections, images).
- Palaeontology.
- Interpretation.
- Concluding summary.
- References.
- Appendices

The draft report will be reviewed by the client, or externally, before submission of the Final Report.

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