# HERITAGE IMPACT ASSESSMENT:
# PROPOSED ZONNEQUA WIND FARM NEAR KLEINSEE, NAMAKWALAND MAGISTERIAL DISTRICT, NORTHERN CAPE

Required under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999).

SAHRA Case No.:

*Report for:*

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1st draft: 25 August 2018
1st revision: 31 August 2018
2nd revision: 26 September 2018

# EXECUTIVE SUMMARY

ASHA Consulting (Pty) Ltd was appointed by Savannah Environmental (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction and operation of a wind farm to the southeast and east of Kleinsee, Namakwaland Magisterial District, Northern Cape. The properties affected by the proposal all fall within the Springbok Renewable Energy Development Zone (REDZ) and are listed below.

| Zonnequa Wind Farm |
| --- |
| Remainder of farm Zonnekwa 326<br>Portion 1 of Farm Zonnekwa 328 |

The project would include up to 56 wind turbines (maximum hub height of up to 130m and tip height of up to 205m), concrete turbine foundations, turbine hardstands, temporary laydown areas, cabling between the turbines, an on-site substation, access roads, a temporary concrete batching plant, and operation and maintenance buildings.

The wind farm study area is relatively flat but with a large north-south trending dune ridge along the western edge and another low, broad one in the east. The substrate is sandy throughout and vegetation is sparse and low.

Palaeontological materials were not observed on the wind farm site but isolated fossil bones could occur within the various sand formations of the area. Archaeological sites were found scattered throughout the sand dune areas but the intervening plain was virtually sterile. Because it is closer to the coast, the western dune cordon had more sites on it than the eastern one. The sites are all artefact scatters with some of those on the western dune ridge having a few shells owing to being closer to the coast. An unusual find was a small cache of two ostrich eggshell flasks, one of which remained whole. Some of these sites are worthy of further research. The various farm buildings present are all 20$^{th}$ century and none are of any significance. A farm graveyard occurs close to the farm buildings. The landscape does carry cultural significance but this area has been incorporated into a REDZ which means that electrical infrastructure is to be expected; no wind farms have yet been developed though. A benefit of this is that it concentrates such developments in one area and allows other areas to remain undeveloped.

The proposed wind farm has been laid out to avoid all currently known archaeological sites, although it is likely that more would still be found in places. Impacts to isolated fossils and unmarked graves are possible but cannot be predicted. No other significant impacts are expected.

Because impacts are not of high significance and can easily be managed, it is recommended that the proposed wind farm and associated infrastructure should be authorised subject to the following conditions which should be included in the conditions of authorisation or the environmental management program as appropriate:

- An archaeologist should be appointed to conduct a final pre-construction survey of the approved layout at least 6 months prior to commencement of construction;
- A chance finds procedure must be implemented for the rescuing of any fossils discovered during construction;

- All work is to be carried out within the authorised construction footprint. Any new areas that may need to be disturbed must be surveyed for archaeological sites prior to disturbance;
- Where possible, built elements should be painted in a colour to match the surrounding landscape;
- Any disturbed areas not required during operation must be rehabilitated after construction; and
- If any archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

# Glossary

**Background scatter**: Artefacts whose spatial position is conditioned more by natural forces than by human agency

**Early Stone Age**: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.

**Handaxe**: A bifacially flaked, pointed stone tool type typical of the Early Stone Age.

**Holocene**: The geological period spanning the last approximately 10-12 000 years.

**Hominid**: a group consisting of all modern and extinct great apes (i.e. gorillas, chimpanzees, orangutans and humans) and their ancestors.

**Heuweltjie:** An ancient termite mound that now forms part of the dorbank horizon.

**Later Stone Age**: Period of the Stone Age extending over the last approximately 20 000 years.

**Middle Stone Age**: Period of the Stone Age extending approximately between 200 000 and 20 000 years ago.

**Pleistocene**: The geological period beginning approximately 2.5 million years ago and preceding the Holocene.

# Abbreviations

**APHP**: Association of Professional Heritage Practitioners

**ASAPA**: Association of Southern African Professional Archaeologists

**BAR**: Basic Assessment Report

**CCS:** crypto-crystalline silica

**CRM**: Cultural Resources Management

**ECO**: Environmental Control Officer

**EIA**: Environmental Impact Assessment

**ESA**: Early Stone Age

**GP:** General Protection

**GPS**: global positioning system

**HIA**: Heritage Impact Assessment

**LSA**: Later Stone Age

**MSA**: Middle Stone Age

**NBKB:** Ngwao-Boswa Ya Kapa Bokoni

**NEMA:** National Environmental Management Act (No. 107 of 1998)

**NHRA**: National Heritage Resources Act (No. 25) of 1999

**PPP:** Public Participation Process

**REDZ:** Renewable Energy Development Zones

**SAHRA**: South African Heritage Resources Agency

**SAHRIS**: South African Heritage Resources Information System

# Contents

# 1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by Savannah Environmental (Pty) Ltd to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction and operation of a wind farm southeast of Kleinsee, Namakwaland Magisterial District, Northern Cape (Figure 1). The properties affected by the proposal are listed in Table 1.

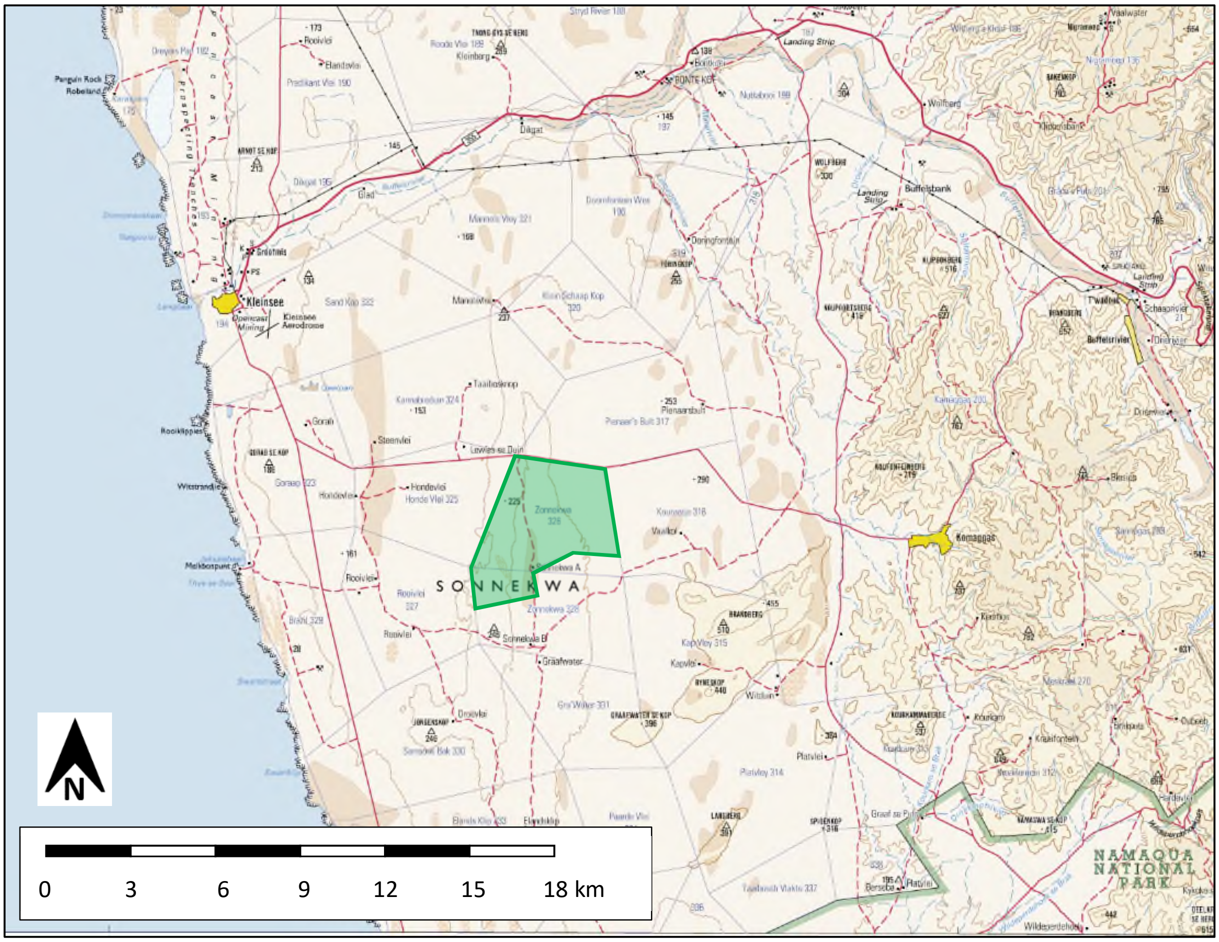


***Figure 1:*** *Extract from 1:250 000 topographic map 2916 showing the location of the site (green polygon). Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.*

***Table 1:*** *List of properties affected by the proposed project.*

| Zonnequa Wind Farm |
|---|
| Remainder of farm Zonnekwa 326<br>Portion 1 of Farm Zonnekwa 326 |

### 1.1. Project description

Genesis Zonnequa Wind (Pty) Ltd is proposing the development of a commercial wind farm and associated infrastructure on a site located approximately 19km south-east of Kleinsee within the Nama Khoi Local Municipality and the Namakwa District Municipality in the Northern Cape Province.

A preferred project site with an extent of ~4434ha has been identified by Genesis Zonnequa Wind (Pty) Ltd as a technically suitable area for the development of the Zonnequa Wind Farm with a contracted capacity of up to 140MW that can accommodate up to 56 turbines. The entire project site is located within Focus Area 8 of the Renewable Energy Development Zones (REDZ), which is known as the Springbok REDZ. Due to the location of the project site within the REDZ, a Basic Assessment (BA) process will be undertaken in accordance with GN114 as formally gazetted on 16 February 2018.

The Zonnequa Wind Farm project site is proposed to accommodate the following infrastructure, which will enable the wind farm to supply a contracted capacity of up to 140MW:

- Up to 56 wind turbines with a maximum hub height of up to 130m. The tip height of the turbines will be up to 205m;
- Concrete turbine foundations of approximately 20 x 20 x 3 m and turbine hardstands;
- Temporary laydown areas which will accommodate the boom erection, storage and assembly area;
- Cabling between the turbines, to be laid underground where practical;
- An on-site substation of up to 100m x 100m (1ha) in extent to facilitate the connection between the wind farm and the electricity grid;
- Access roads to the site (with a width of up to 10m) and between project components (with a width of approximately 8m);
- A temporary concrete batching plant; and
- Operation and Maintenance buildings including a gate house, security building, control centre, offices, warehouses, a workshop and visitors centre.


***Figure 2:*** *Aerial view of the study area showing the proposed facility layout (turbines marked in blue, roads in green, substation in orange, laydown area in light green and two offices in turquoise).*

1.1.1. Aspects of the project relevant to the heritage study

All aspects of the proposed development are relevant since excavations for foundations and/or services may impact on archaeological and/or palaeontological remains, while all above-ground aspects create potential visual (contextual) impacts to the cultural landscape and any significant heritage sites that might be visually sensitive.

### 1.2. Terms of reference

ASHA Consulting was appointed to assess the potential impacts to heritage resources and produce a Heritage Impact Assessment (HIA). The assessment should comply with the relevant legislation and be based on a field survey of the wind farm. Following S.38(3) of the National Heritage

Resources Act (No. 25 of 1999), all relevant aspects of heritage are to be considered in the assessment.

### 1.3. Scope and purpose of the report

An HIA is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued by them for consideration by the National Department of Environmental Affairs (DEA) who will review the Basic Assessment Report[1] (BAR) and grant or refuse authorisation. The HIA report will outline any management and/or mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the Environmental Management Programme (EMPr) and the conditions of authorisation should this be granted.

### 1.4. The author

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting HIAs and archaeological specialist studies in South Africa (primarily in the Western Cape and Northern Cape provinces) since 2004 (please see curriculum vitae included as Appendix 1). He has also conducted research on aspects of the Later Stone Age in these provinces and published widely on the topic. He is an accredited heritage practitioner with the Association of Professional Heritage Practitioners (APHP; Member #43) and also holds archaeological accreditation with the Association of Southern African Professional Archaeologists (ASAPA) CRM section (Member #233) as follows:

- Principal Investigator: Stone Age, Shell Middens & Grave Relocation; and
- Field Director: Colonial Period & Rock Art.

### 1.5. Declaration of independence

ASHA Consulting (Pty) Ltd and its consultants have no financial or other interest in the proposed development and will derive no benefits other than fair remuneration for consulting services provided.

## 2. HERITAGE LEGISLATION

The National Heritage Resources Act (NHRA) No. 25 of 1999 protects a variety of heritage resources as follows:

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old;
- Section 36: graves and human remains older than 60 years and located outside of a formal cemetery administered by a local authority; and

[1] Note that the project falls with a Renewable Energy Development Zone (REDZ) and as such is to be assessed via a Basic Assessment and not a full Environmental Impact Assessment.

- Section 37: public monuments and memorials.

Following Section 2, the definitions applicable to the above protections are as follows:

- Structures: "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";
- Palaeontological material: "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";
- Archaeological material: a) "material 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"; b) "rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation"; c) "wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation"; and d) "features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found";
- Grave: "means a place of interment and includes the contents, headstone or other marker of such a place and any other structure on or associated with such place"; and
- Public monuments and memorials: "all monuments and memorials a) "erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government"; or b) "which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual."

While landscapes with cultural significance do not have a dedicated Section in the NHRA, they are protected under the definition of the National Estate (Section 3). Section 3(2)(c) and (d) list "historical settlements and townscapes" and "landscapes and natural features of cultural significance" as part of the National Estate. Furthermore, Section 3(3) describes the reasons a place or object may have cultural heritage value; some of these speak directly to cultural landscapes.

Section 38(8) of the NHRA states that if an impact assessment is required under any legislation other than the NHRA then it must include a heritage component that satisfies the requirements of S.38(3). Furthermore, the comments of the relevant heritage authority must be sought and considered by the competent authority prior to the issuing of a decision. Under the National Environmental Management Act (No. 107 of 1998; NEMA), as amended, the project would require an Environmental Impact Assessment (EIA) but because it falls within a Renewable Energy Development Zone (REDZ) a Basic Assessment process may be followed. The present report provides the heritage component. Ngwao-Boswa Ya Kapa Bokoni (Heritage Northern Cape; for built environment and cultural landscapes) and the South African Heritage Resources Agency (SAHRA for archaeology and palaeontology) are required to provide comment on the proposed project in order to facilitate final decision making by the National Department of Environmental Affairs.

# 3. METHODS

## 3.1. Literature survey and information sources

A survey of available literature was carried out to assess the general heritage context into which the development would be set. This literature included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS). The 1:50 000 map and historical aerial images were sourced from the Chief Directorate: National Geo-Spatial Information.

## 3.2. Field survey

The wind farm site was subjected to a foot survey on 26$^{th}$ and 27$^{th}$ February the 1$^{st}$ and 2$^{nd}$ March 2018. On the wind farm site the survey was guided by provisional turbine placements provided by the developer. The survey was in late summer, although in this dry climate seasonality has no effect on the degree of visibility of archaeological remains on the ground. During the survey, the positions of finds were recorded on a hand-held Global Positioning System (GPS) receiver set to the WGS84 datum. Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

The naming of archaeological sites follows a convention long in use in Namaqualand and has initial letters for the farm name, a year of discovery and a site number for that year. The farm acronyms are as follows:

- ZK: Zonnekwa 326; and
- ZN: Zonnekwa 328.

Site names were only allocated when anthropogenic influence was evident (i.e. cultural material was seen) or, in the case of only stone artefacts, when there were five or more artefacts that were fairly clearly associated.

## 3.3. Specialist studies

A separate assessment of palaeontological heritage was commissioned. This was carried out as a desktop study by John Pether. This study is referenced in the present HIA and included as Appendix 2 of this report. It should be noted that the palaeontological assessment covers both this wind farm site and a neighbouring wind farm site which were studied together but are being described in separate HIAs as part of separate applications.

## 3.4. Impact assessment

For consistency among specialist studies, the impact assessment was conducted through the application of a scale supplied by Savannah Environmental.

## 3.5. Grading

S.7(1) of the NHRA provides for the grading of heritage resources into those of National (Grade I), Provincial (Grade II) and Local (Grade III) significance. Grading is intended to allow for the identification of the appropriate level of management for any given heritage resource. Grade I and II resources are intended to be managed by the national and provincial heritage resources authorities respectively, while Grade III resources would be managed by the relevant local planning authority. These bodies are responsible for grading, but anyone may make recommendations for grading.

It is intended under S.7(2) that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. SAHRA (2007) has formulated its own system[2] for use in provinces where it has commenting authority. In this system sites of high local significance are given Grade IIIA (with the implication that the site should be preserved in its entirety) and Grade IIIB (with the implication that part of the site could be mitigated and part preserved as appropriate) while sites of lesser significance are referred to as having 'General Protection' (GP) and rated GP A (high/medium significance, requires mitigation), GP B (medium significance, requires recording) or GP C (low significance, requires no further action).

### 3.6. Consultation

The NHRA requires consultation as part of an HIA but, since the present study falls within the context of a BAR which includes a public participation process (PPP), no dedicated consultation was undertaken as part of the HIA. Interested and affected parties would have the opportunity to provide comment on the heritage aspects of the project during the PPP of the BAR.

### 3.7. Assumptions and limitations

The field study was carried out at the surface only and therefore any completely buried archaeological sites or palaeontological occurrences would not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. Because the site was very large, it was not possible to conduct a comprehensive surface survey. Instead, the provisional turbine layout as provided by the developer was used to guide the survey. Although any visible locations that seemed as though they might yield archaeology were visited, it is quite likely that further archaeological sites will be present in the intervening spaces. Note that no road or internal cabling layout was provided and that the survey therefore does not follow road or cable linkages between turbines as might be implemented. Also, a number of extra turbine locations were included in the east after the survey with the result that this area was not covered on the ground. This is not a significant limitation since the archaeology is 'banded' in its distribution (see below) and no other sites were found at a similar distance from the coast.

## 4. PHYSICAL ENVIRONMENTAL CONTEXT

### 4.1. Site context

The wind farm study area is a rural context with large farms used for small stock grazing (including sheep farming). Minimal infrastructure is present with this being limited to occasional farm houses and associated outbuildings, farm roads and tracks and wire fences. The tar road between Kleinsee and Koingnaas lies some 8.8 km to the west of the western edge of the wind farm study area, while the gravel road between that road and Komaggas abuts the study area to its north.

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[2] The system is intended for use on archaeological and palaeontological sites only.

Although several other renewable energy facilities have been proposed in the area, none have yet been constructed which means that the area retains its rural context with mining along the river and also the coastline further to the northwest.

### 4.2. Site description

The wind farm study area is a very sandy environment with undulating topography. There are different 'bands' of landscape as one moves from west to east and which are relevant to the archaeology. In the western part of the wind farm study area there is a band of tall sand dunes that extends from north to south and is approximately 5 km wide. It extends further west than the western boundary of the study area. There are several minor dune ridges within this generally taller band but over most of this area there are fewer prominent dune crests than is the case in the far south. There are occasional 'deflating areas' on some dune tops (Figure 3) with proper deflation hollows found to be very rare (Figure 4). A further broad flat plain at least 3.0 km wide lies to the east of the belt of dunes and this has isolated low dunes scattered across it (Figure 5). These dunes very likely mantle *heuweltjies*. A very low band of sand dunes lies in the far east of the study area.

***Figure 3:*** *View towards the east from the broad band of dunes in the western part of the study area. The broad flat plain to the east is visible in the background but the distant mountains are well beyond the study area. This photograph is of a site described as being in a 'deflating area' (waypoint 28).*

***Figure 4:*** *View across a site described as being in a 'deflation hollow' (waypoint 104B).*

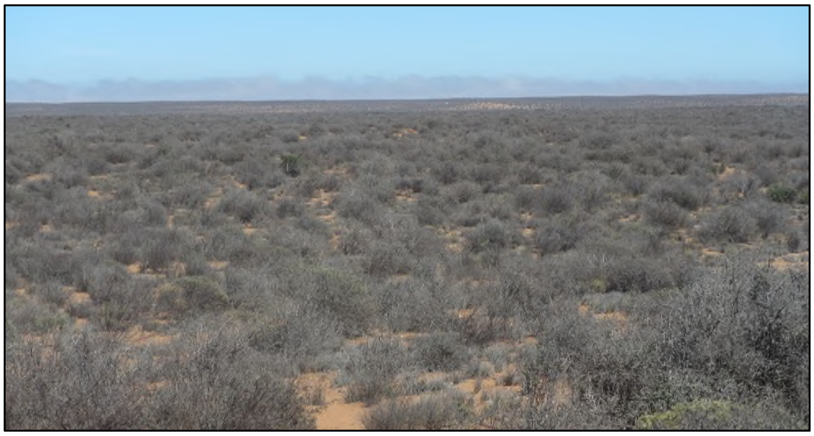

***Figure 5:*** *View towards the east across the flat plains in the north-eastern part of the wind farm area.*

An important component of Namaqualand is the presence of a hardened soil horizon – known as dorbank – below the cover sands. This dorbank is revealed in borrow pits which have been excavated and occasionally in other areas where erosion has removed the aeolian cover sands, such as on the southern bank of the Buffels River.

# 5. ARCHAEOLOGICAL AND HISTORICAL CONTEXT

This section of the report contains the desktop study and establishes what is already known about the archaeological heritage in the vicinity of the study area. This will assist in the interpretation and understanding of the newly reported material.

## 5.1. Archaeological aspects

Early Stone Age (ESA) materials in Namaqualand have mostly been found fairly close to the coastline and are often found in the same contexts as Middle Stone Age (MSA) artefacts. Halkett (2002) reported a large scatter of ESA artefacts from Kleinsee, while Orton and Webley (2012b) found ESA and MSA artefacts associated with fossil bones on the high ground to the north of the Buffels River, northeast of Kleinsee. Much further south, in Western Cape, Hart and Halkett (1994) excavated an ESA sample adjacent to a quarried silcrete outcrop, while not far away Orton (2017) found extensive scatters of ESA material – including abundant handaxes – at the interface of the dorbank and aeolian cover sands. Some 20 km north of Kleinsee, Orton and Halkett (2006) described an extensive silcrete outcrop that displayed evidence of quarrying. There were scatters of ESA and MSA artefacts located across the outcrop. Further inland, to the southeast of the present study area, Morris and Webley (2004) reported scatters of ESA artefacts, including handaxes, amongst sand dunes on the coastal plain and around pans.

Middle Stone Age (MSA) material is generally more commonly reported, but further inland tends to occur as isolated artefacts or as very ephemeral scatters. To the northwest of Komaggas Dreyer (2002) reported MSA artefacts on quartzite and hornfels associated with river gravel about 1 km from the Buffels River. Van Pletzen-Vos and Rust (2011) found MSA quartz artefacts on the western and northern outskirts of Komaggas. In the Kamiesberg Mountains, Howieson's Poort-type implements belonging to the MSA were found in Keurbos Cave some 15km north-east of Garies (Webley 1992), while MSA implements were found in excavations at a small rock shelter called Wolfkraal close to Kharkams (Webley 1984). Near Garies in central Namaqualand, Webley and Halkett (2010) reported on a MSA factory site on Swartkop, an outcrop of dark, fine-grained rock which appears to have been targeted by prehistoric populations. Closer to the coast Orton and Halkett (2005) found some Howieson's Poort bifacial points associated with shell in a dunefield 22 km south of the present study area, but the relationship between the shell and artefacts might be spurious. Halkett and Hart (1997) and Jerardino *et al.* (1992) reported scatters of MSA artefacts north of Kleinsee and at the Groen River Mouth respectively.

Later Stone Age (LSA) material is regularly found throughout Namaqualand. The coastal and near-coastal areas, however, have by far the greatest number of reported sites (Dewar 2008; Orton 2012). Many thousands of shell middens and scatters occur along the coast, some of them preserving rich assemblages of cultural materials and food remains. While these focus on the area within about 2 km to 3 km of the coast, shell scatters have been found along the Buffels River up to 10 km inland (Orton & Webley 2012b). Almost all sites are open sites with just one coastal rock shelter known to contain LSA deposits (Webley 1992. 2002). Inland the best sites tend to be rock shelters with the majority of other sites being relatively ephemeral open artefact scatters. Most work in the inland region has been done by Webley (1986, 1992, 2007) with a focus on rock shelters. Although not common, rock art has been recorded at various locations in the central part of Namaqualand (Orton 2013; Morris & Webley 2004). Orton (2013) ascribes the geometric rock art designs to Khoekhoe herders. Southeast of the present study area, in the Namaqualand National Park, both representational and geometric rock art sites were recorded (Morris & Webley 2004).

The last 2000 years are especially important for archaeological research in Namaqualand. Archaeological sites from this period with pottery are reported from a number of sites and are believed to be associated with the introduction of herding and/or pastoralism to the region some 2000 years ago. The region is known to be important in terms of the beginnings of herding, but the details of how it happened are still highly contested (Orton 2015). The archaeology supports the historic information that pastoralist groups (the ancestors of the Little Namaqua Khoekhoen) were occupying this area at and before the time of colonial contact.

Two other surveys have been conducted in close proximity to the present study area. Magoma's (2016) linear survey through its eastern part yielded only isolated artefacts, while immediately northwest of the present study area Orton and Webley (2012a) found large numbers of LSA sites spread across the landscape. Slightly further but on the adjoining farms to the east and southeast, Orton (2018) found a number of LSA sites on the ridges of the inselberg formed by Brandberg, Byneskop and Graafwater se Kop. The sites consisted only of stone artefacts. Figure 6 shows the distribution of archaeological sites known to the author in the vicinity of the wind farm site.

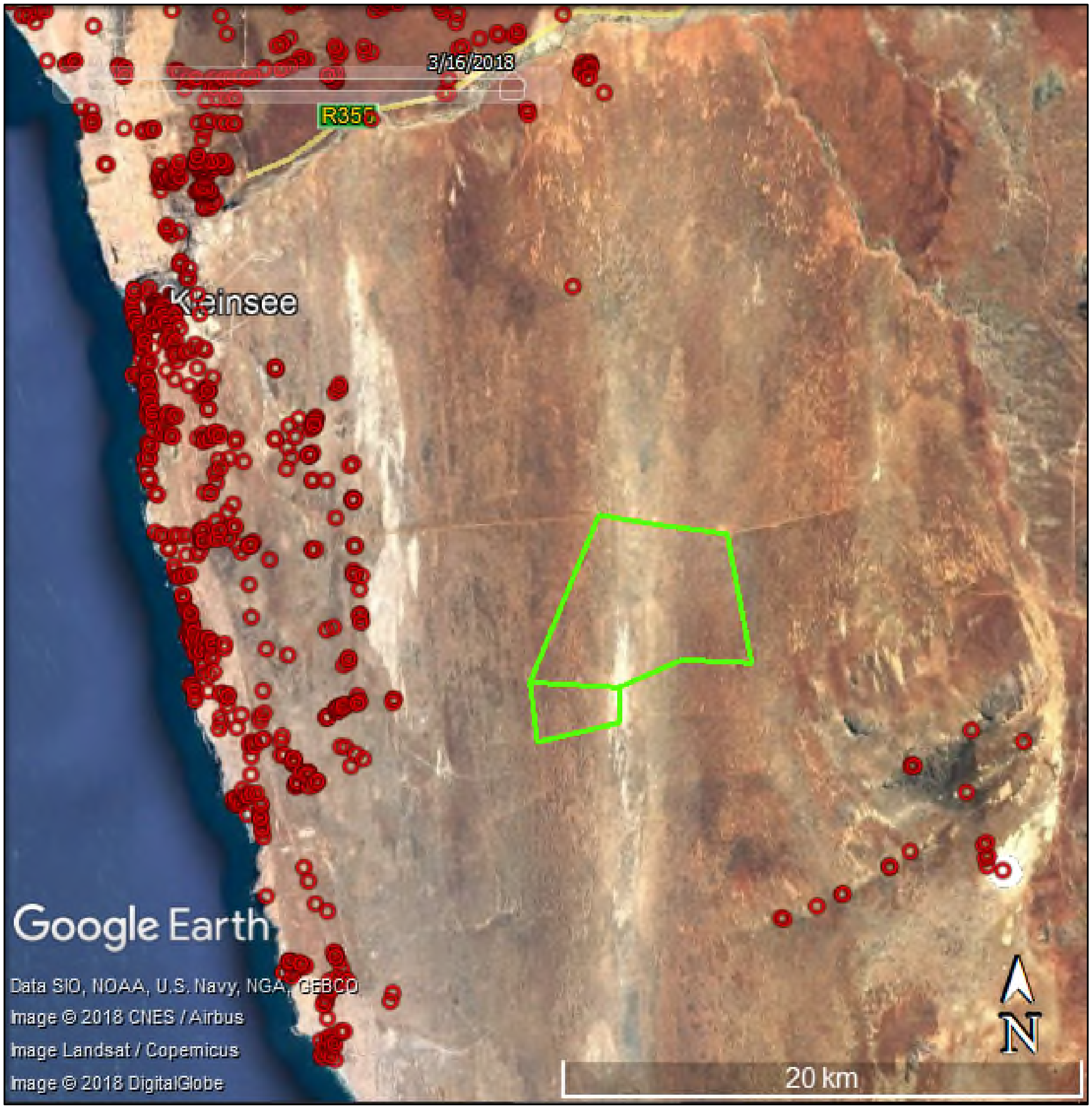


***Figure 6:*** *Map showing the distribution of archaeological sites known to the author.*

### 5.2. Historical aspects

Namaqualand is quite remote and relatively unproductive from an agricultural point of view. As a result, it does not have as deep a history as many other parts of South Africa. Although the little settlement of Gootmis just inland of Kleinsee and the mission station at Komaggas dates back into the 19th century, the larger towns of Kleinsee and Koingnaas relate to 20th century diamond mining.

Grootmis was historically important because it had water. An annotation on a 1907 British Military map states that Grootmis had an unlimited water supply (Source: Pietermaritzburg Archives). The very large number of shell scatters found in the area by Orton and Webley (2012b) suggests that this water source had been available for some time. It probably stopped yielding water when De Beers dammed the river and commenced with the abstraction of water.

Komaggas (Camaggas) is first mentioned by Gordon in 1779. Komaggas (the farm is spelled Kamaggas, a form that also appears on some early maps) received a Certificate of Occupation on 9 November 1843, granting the Cloete family the right of occupation on the land.

There are various oral accounts of the relationship between Ryk Jasper Cloete and the Nama kaptein kXurib who used the Komaggas Fountain as his main water source. Bregman (2010) suggests that he acquired the land through his marriage to the kaptein's daughter. Jasper Cloete utilised land up to the Orange River to graze his stock. A mission station of the London Missionary Society (LMS) was set up at Komaggas in 1829 and the farm was surveyed in 1831. It became a station of the Rhenish Missionary Society in 1843 and then the N.G. Church from 1936 (Raper n.d.).

Bregman (2010) provides a list of the farms surrounding and in the vicinity of Komaggas, including the date that they were first registered. Farms to the west of Komaggas were granted to colonists under quitrent title only after 1855. Mining companies were seeking land in the area because of the commencement of copper mining. Closer to the coast, the dry plains between the Swartlintjies and Buffels Rivers were left open as Crown Land – this is the zone in which the present study area lies. Despite the increasing private ownership of farms in the area, herders from Komaggas were still able to access grazing lands outside of the reserve because the farms were not completely fenced and access was gained at certain places. However, they had no formal title to the land. In 1925 diamonds were discovered on the farm Oubeep, south of Port Nolloth, and in 1926 at Kleyne Zee, both by Jack Carstens. Mining commenced at the latter in 1927 and the town of Kleinsee was soon established (Rebelo 2003). Much of the coastline was then bought up for diamond mining and access for grazing was closed.

## 6. FINDINGS OF THE HERITAGE STUDY

All finds from the field survey are listed and described in Table 2.

***Table 2:*** *List of heritage resources recorded during the survey. The number of hours in the significance column indicates the estimated amount of time that might be required on site if a site cannot be avoided and mitigation is required.*

| Waypoint | Site name | Co-ordinates | Description | Significance<br>Mitigation |
|---|---|---|---|---|
| 028 | ZN2018/020 | S29 49 35.8<br>E17 13 29.9 | Moderate density scatter of *C. granatina* and *S. granularis* with quartz (9 seen) in a slight deflation on a hilltop. Also 2 quartz and 2 CCS artefacts in a second small deflation about 10 m east. There was a CCS thumbnail scraper here. | Low-medium<br>**2 hours** |
| 029 | ZN2018/021 | S29 49 34.0<br>E17 13 28.1 | A small, dense ostrich eggshell scatter on a hilltop. There were three burnt pieces which shows human involvement. | Low |
| 030 | --- | S29 49 54.7<br>E17 13 01.5 | Small deflation hollow on a hilltop containing three quartz flakes and a CCS core. Too few artefacts to be called a site. | --- |
| 101 | ZK2018/001 | S29 46 50.1<br>E17 13 47.7 | Ephemeral quartz scatter in a small hilltop deflation hollow. Only 5 artefacts seen. | Very low |
| 102 | ZK2018/002 | S29 47 05.5<br>E17 14 15.6 | A fairly wide scatter of ostrich eggshell fragments on the eastern slope of the large dune cordon. There was also one quartz flake showing human presence. | Very low |
| 103 | ZK2018/003 | S29 46 50.5<br>E17 14 50.4 | An ostrich eggshell flask cache with two flasks located immediately north of the summit of a low hill. One egg is whole and the other broken. Only one mouth fragment was seen but overall there is well less eggshell than would be needed for a whole shell so there must have not been more than two shells. The whole shell's mouth is 14 | Low-medium<br>**1 hour** |

| | | | | |
|---|---|---|---|---|
| | | | x 18 mm and is quite irregular. The mouth fragment is similarly irregular. | |
| 104A | ZK2018/004 | S29 47 41.9<br>E17 13 41.8 | Patch A: A light artefacts scatter in a hilltop deflation hollow. It includes artefacts of quartz (60+ seen) and CCS (8 seen). There were also several fragments of ostrich eggshell (8 seen).<br>Patch B: A light artefact scatter in a second dunetop deflation alongside the above one. It has artefacts of quartz (40+ seen) and CCS (5 seen). There is also some ostrich eggshell throughout but a dense scatter in the southern end of the deflation hollow. There were three shell fragments of *C. granatina* and *S. granularis*. An enamel basin lies at the southern end of the deflation hollow and some rusted metal fragments in the south-eastern part, a little up the edge. | Low-medium<br>**8 hours** |
| 104B | | S29 47 42.1<br>E17 13 42.5 | | |
| 105 | ZK2018/005 | S29 47 51.1<br>E17 13 14.8 | A dense ostrich eggshell cluster on a sandy hilltop. A single CCS flake was found about 5 m to the south of the cluster. The eggshell may not be archaeological but this cannot be ascertained with any certainty. | Very low |
| 106 | ZK2018/006 | S29 48 42.8<br>E17 13 55.8 | An ephemeral artefact scatter in a small deflation hollow located on the upper slope on the eastern edge of the large dune cordon. It included artyefacts of quartz (2 seen) and CCS (3 seen) as well as a quartzite hammer stone/upper grindstone. | Very low |
| 107 | ZK2018/007 | S29 48 36.4<br>E17 14 02.4 | A moderate density scatter of ostrich eggshell fragments in a deflating area on a hilltop. There are no artefacts present but two eggshell fragments show evidence of having been struck from the outside and two are burnt. | Very low |
| 108 | ZK2018/008 | S29 48 28.1<br>E17 13 48.2 | Ephemeral artefact scatter in a hilltop deflation hollow. Only five quartz artefacts were seen. | Very low |
| 109 | --- | S29 48 41.9<br>E17 14 52.9 | Small family graveyard located to the east of the waypoint and with a single grave dating to 2008 (not visited). | --- |
| 110 | ZK2018/009 | S29 46 04.4<br>E17 14 36.9 | A light artefact scatter in a deflated area on a sandy hilltop on the eastern edge of the large dune cordon overlooking the plains below. It has quartz (50+ seen) and CCS (1 notched flake seen) artefacts as well as a quartzite hammer stone/anvil/irregular core, ostrich eggshell fragments (10+ seen), some burnt bones fragments, a rim potsherd, fragments of a leather shoe, two modern clear glass bottles (one of them broken). The pot rim had either a flared or a vertical orientation and its form was tapered. The sherd was very thin. A second deflation hollow just to the east had an ephemeral scatter of quartz and quartzite with one *S. argenvillei* fragment and a piece of green glass. | Low-medium<br>**2 hours** |
| 111 | ZK2018/010 | S29 45 34.0<br>E17 14 44.4 | An ephemeral mixed scatter located on a 'foothill' at the eastern base of the large dune cordon. It has a silcrete flake, a quartzite cobble, two ostrich eggshell fragments, a historical wine bottle base in two pieces and another glass fragment. The glass has bubbles in it indicating it to not be modern. It shows no signs of flaking. All items were widely scattered over the hill. | Very low |
| 112 | ZK2018/011 | S29 45 37.1<br>E17 14 28.5 | A light scatter of ostrich eggshell fragments (11 seen) on a sandy hilltop. Although no artefacts were seen the scatter must be anthropogenic. | Very low |
| 113 | --- | S29 45 12.7<br>E17 14 30.3 | A patch of background scatter artefacts associated with the hardpan at a borrow pit. | Very low |

## 6.1. Palaeontology

This summary comes from Pether (2018) (Appendix 2). The affected surficial formations include early to mid-Holocene dunes of the Hardevlei Formation and earlier late Quaternary coversands of the Koekenaap Formation. Beneath these unconsolidated sands are compact, pedogenically-altered aeolianites termed "Dorbank Units" which are fossil dune plumes of later mid-Quaternary age. An older dorbank dune plume underlies the eastern part of the broader study area, while a later dorbank dune plume underlies the western part where the Zonnequa Wind Farm turbines will be situated. Between these dune plume ridges is a non-depositional area which is closely underlain by pale pedocrete which is likely to have formed in early mid-Quaternary aeolianites equivalent to the Olifantsrivier Formation.

The primary palaeontological concern is the fossil bones that are sparsely distributed in these aeolian deposits. Although sparse in aeolian Dorbank Units and overlying coversands and dunes, they are of high scientific significance and important for palaeoclimatic, palaeobiological and biostratigraphic studies. The fossil material in these deposits is a sample of the middle and late Quaternary fauna of the Namaqualand coast.

### 6.2. Archaeology

The wind farm area proposed for the development was found to host a number of small archaeological sites. Although an effort was made to try to reach all potentially sensitive locations in reasonably close proximity to the turbine placements provided for the survey, it is likely that more similar archaeological sites exist in the broader landscape. The archaeology is 'banded' following the landscape character discussed in Section 4.2 with the vast majority of sites being in the large dune cordon along the western side of the study area or along its eastern edge. There seemed to be far fewer significant sites towards the north and this likely relates to the fact that the dune cordon becomes somewhat flatter and has less sandy deflations as one moves towards the north. Figure 7 shows an example of a small site in a deflation and Figure 8 a CCS thumbnail scraper from the same site. Another site, this time along the eastern margin of the dune cordon and in the northern part of the wind farm study area contained a mixture of LSA and recent items. The site was on a hill top with a view across the plains to the east (Figure 9). Pottery (Figure 10), stone artefacts (Figure 11), and ostrich eggshell fragments are all LSA in age, while a leather shoe sole (Figure 12) and fragments of two bottles are relatively recent.

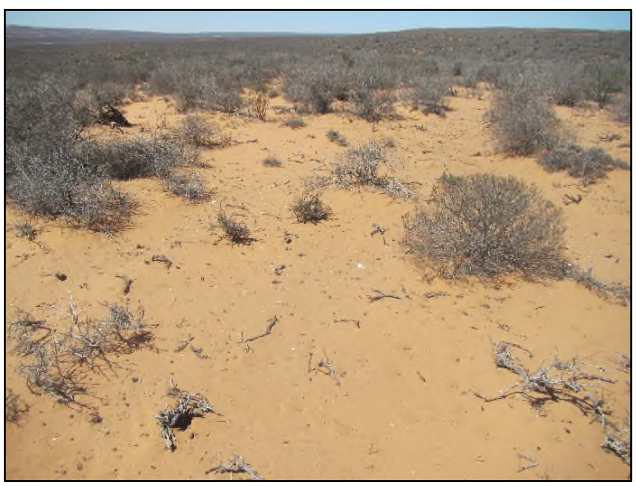

***Figure 7:*** *The surface of ZN2018/020 (waypoint 028) showing a light scatter of shells and stone artefacts in a small deflation.*

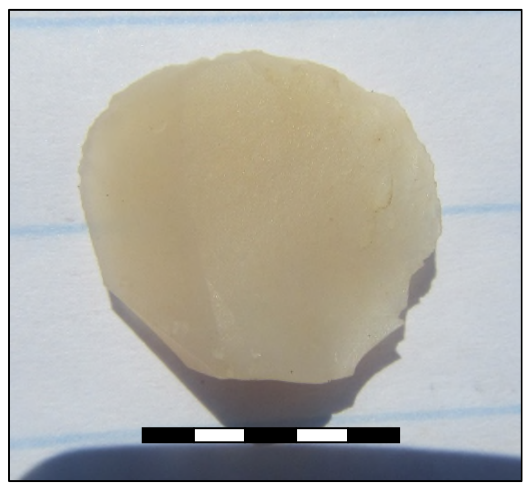

***Figure 8:*** *A CCS thumbnail scraper from ZN2018/020. Scale in 2 mm intervals.*

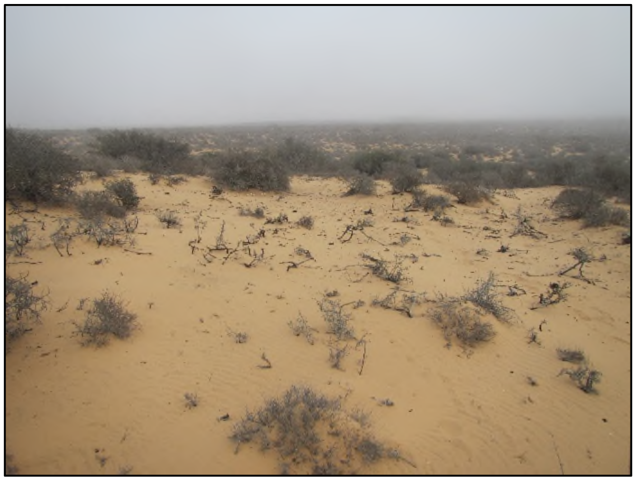

***Figure 9:*** *View of the surface of ZK2018/009 (waypoint 110) located in a deflated area along the eastern edge of the large dune cordon.*

***Figure 10:*** *Pottery rim sherd from ZK2018/009 (waypoint 110). Scale in cm.*

***Figure 11:*** *A quartzite cobble from ZK2018/009 (waypoint 110) that has been used as a hammer stone, an anvil and a core. Scale in cm.*

***Figure 12:*** *The leather shoe sole found at ZK2018/009 (waypoint 110).*

Inland of this dune belt is an area of low-lying flat terrain characterised by pale sand. It was found to be virtually devoid of archaeological sites and materials, even in places where low sand hills occur. Two occurrences were recorded in this zone. One was of some background scatter artefacts in quartz and CCS and some ostrich eggshell fragments at an area where the cover sands had been removed (waypoint 057). The second, ZK2018/003 (waypoint 103), was on a low sand hill at the eastern edge of the flat plain. It consisted of a small cache of two ostrich eggshells, one of them whole and one broken (Figure 13). The flask mouths were not as smoothly rounded as is normally expected (Figure 14).

***Figure 13:*** *View of the ostrich eggshell cache at ZK2018/003 (waypoint 103).*

***Figure 14:*** *The mouth of the whole ostrich eggshell and the fragment of a second mouth from ZK2018/003 (waypoint 103). Scale in 5 mm intervals.*

### 6.3. Graves

No precolonial graves were discovered during the survey. No historical graves or graveyards were present. The graveyard on Zonnekwa 326 contains a single grave dated 2008. It is quite likely that unmarked precolonial graves will be present in the sand dunes but their locations cannot be predicted and if found they have to be dealt with on a case by case basis.

### 6.4. Built environment

No buildings will be directly impacted by the proposed project and large buffers are always built into wind farm project designs. Only one farm complex, that on Zonnekwa 326, lies within the wind farm study area. Although not examined in detail on site, it is evident from the 1942 aerial photograph that a complex was present but was very much smaller than that of today (Figure 15). The majority of structures are clearly relatively modern (Figures 16 & 17).

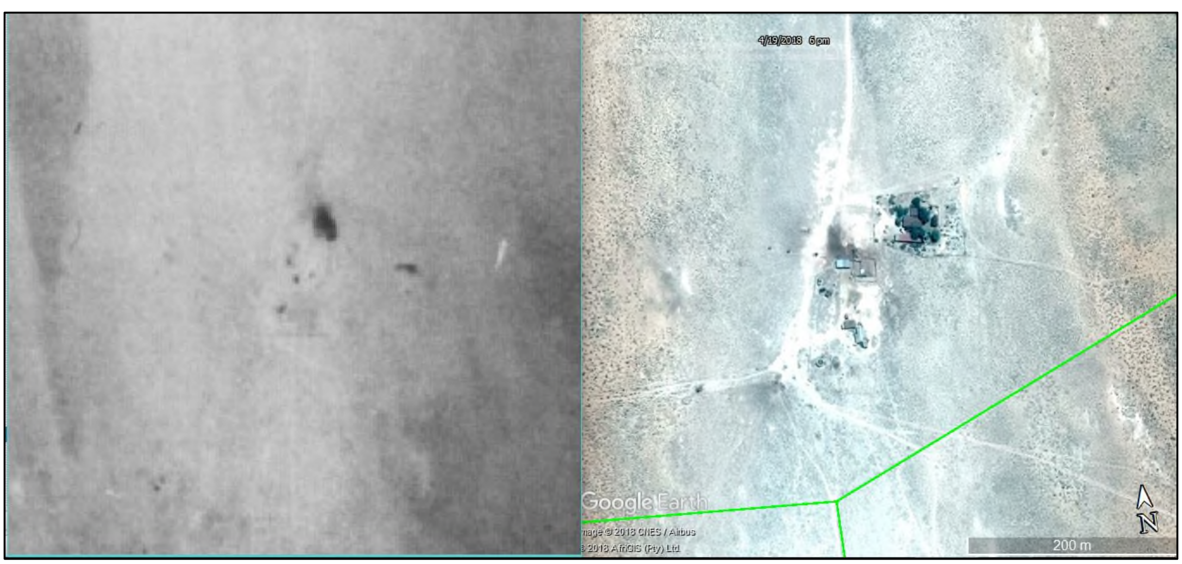

***Figure 15:*** *Aerial views of the Zonnekwa 326 farm complex from 1942 (Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za) and 2004 (Source: Google Earth) showing the complex to be much smaller in 1942*

***Figure 16:*** *View of the main farm house at Zonnekwa 326 as seen from the south.*

***Figure 17:*** *View of the outbuildings at Zonnekwa 326 as seen from the southeast.*

## 6.5. Cultural landscape

The site is situated in a remote location and, being only very minimally developed, is largely considered a natural landscape rather than a rural one. The exception, of course, is the mining landscape located to the north where the human imprint is far greater. Natural heritage also requires consideration because of the visual amenity provided by aesthetically pleasing landscapes. Figures 16 and 17 show all the built infrastructure present on the farm portions earmarked for the wind farm with the only other anthropogenic features on the landscape being farm tracks/roads and fences, along with the occasional borrow pit alongside the larger gravel roads. The landscape conveys a sense of remoteness and inhospitability that is a result of the very frequent strong winds, the low scrubby vegetation and seemingly endless sand flats and dunes. Importantly, it is a fairly flat landscape with the tallest anthropogenic features being wind pumps – aside from the mine dumps further afield. Figures 3 and 5 show the nature of the wind farm site.

The archaeological cultural landscape should also be considered, although it is not typically visible. This cultural landscape consists of a multitude of individual archaeological sites classifiable as a Type 3 precolonial cultural landscape (Orton 2016). Figure 18 shows another view of Figure 6 but with the newly reported sites (identified during the site visit) added onto it. It is clear that with wider survey this landscape would be shown to host many more sites, although densities would naturally reduce away from the sea.

It is important to note that the study area lies within a REDZ and that renewable energy developments are therefore expected to be focussed in this area. A number of developments are proposed and one authorised, and with construction, would add a new 'layer' to the cultural landscape which will intensify the presence of industry and infrastructure development in the area. Also, the 400 kV Eskom power line has been authorised and will be constructed in the near future.

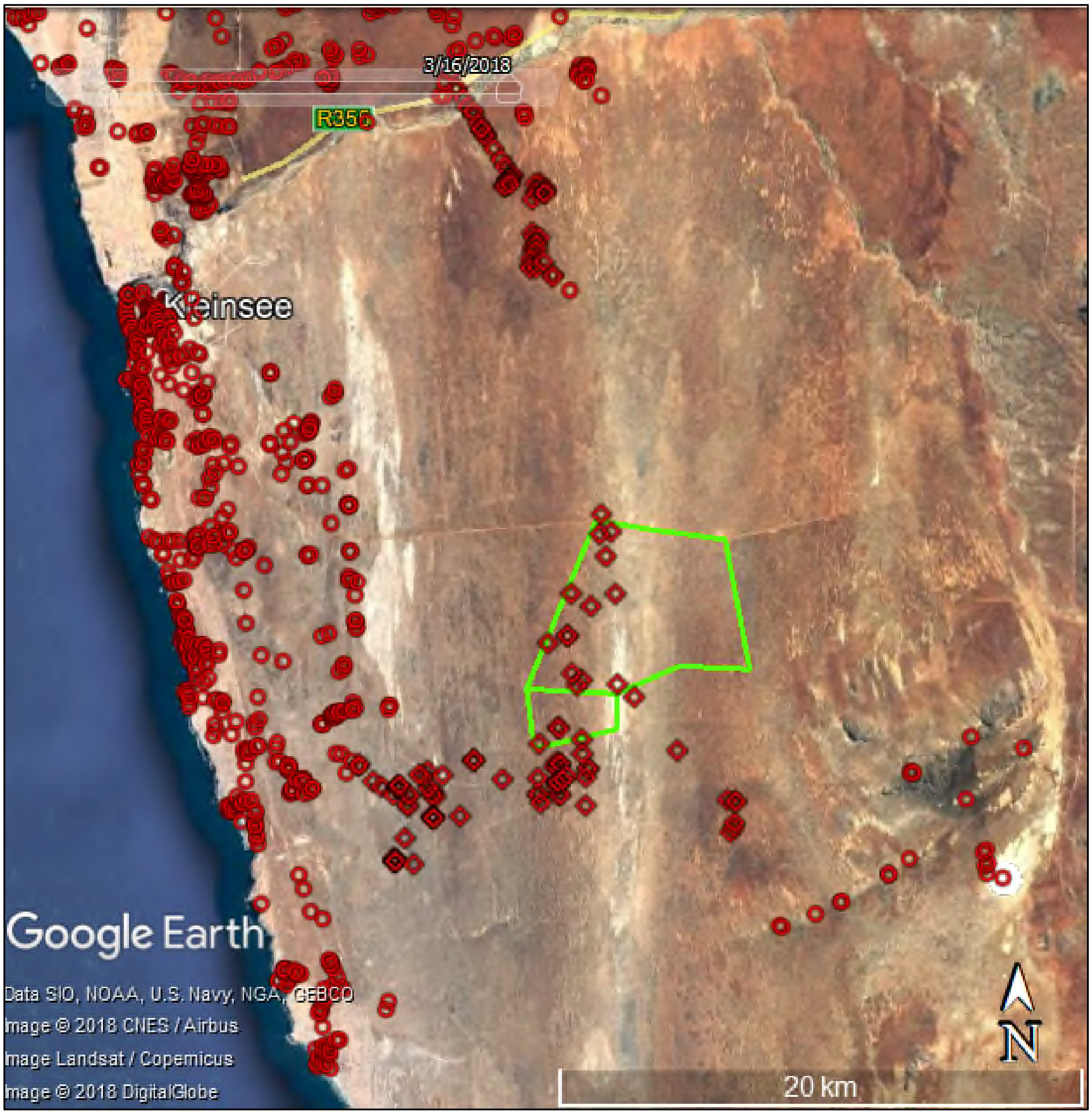


***Figure 18:*** *Aerial view of the study area and wider surroundings showing previously known archaeological resources as well as those discovered during the survey for the proposed Zonnequa Wind Farm (including finds in another wind farm site which will be reported on separately).*

### 6.6. Summary of heritage indicators

The only palaeontological resources of concern are isolated bones from the middle and late Quaternary that may occur within any of the sand units present in the study area. The most frequent heritage resources present are small LSA archaeological sites. They are scattered throughout the dune areas in relative densities but tend to be largely absent from the flat plains. While no graves older than 60 years were discovered, unmarked precolonial graves could be present almost anywhere in the study area. Some structures older than 60 years are present in the study area but located well away from the development. The cultural landscape is minimally developed and is better regarded as a remote, inhospitable natural landscape. Because of its very rich archaeological history, the landscape is considered to be a precolonial cultural landscape.

### 6.7. Statement of significance and provisional grading

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ''cultural significance'' means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. Note that, in line with the SAHRA grading system, only archaeological and palaeontological heritage is assigned provisional grades.

Any fossil bones found would have high cultural significance for their scientific value and would be rated as 'GP A' resources.

The archaeological resources are deemed to have medium cultural significance for their scientific value. Those more important sites can be assigned a field rating of 'GP A', but many others are considered to be 'GP B' or 'GP C'.

Graves (older than 60 years) are deemed to have high cultural significance for their social value but none are yet known from the study area. They would be allocated a rating of IIIA.

The built environment is deemed to be of low cultural significance for its architectural, historical and social values.

The historical/recent cultural landscape is deemed to have low-medium cultural significance for its aesthetic value but the archaeological cultural landscape is of medium significance for its scientific value and could be assigned a field rating of IIIB.

## 7. ASSESSMENT OF IMPACTS

This section assesses the significance of the expected impacts associated with the development of the Zonnequa Wind Farm. Other wind energy facility developments in the area considered in the assessment of cumulative impacts are indicated in Figure 19.

### 7.1. Impacts to palaeontological resources

Impacts to palaeontological resources would occur only during the construction phase when foundations and cable trenches are excavated. The impacts would be direct since the excavations might damage or destroy fossils as they are uncovered. The probability of impacts occurring is probable with the resultant significance of impacts being **Medium**. With mitigation the status becomes positive because of the potential gain in knowledge from access to deposits and fossils that would otherwise have remained buried and undiscovered. The significance would be **Medium**. There are no fatal flaws expected from a palaeontological perspective. The impact assessment summary for palaeontology is shown in Table 3.

***Table 3:*** *Assessment of palaeontological impacts.*

| | | |
|---|---|---|
| ***Nature: Direct destruction of or damage to fossil bones or resources through excavation of foundations and trenches.*** | | |
| | **Without mitigation** | **With mitigation** |
| ***Extent*** | Local (2) | Local (2). If important fossil find occurs, the rating becomes regional-international (3-5) |
| ***Duration*** | Permanent (5) | Permanent (5) |
| ***Magnitude*** | Low (4) | Low (4) |
| ***Probability*** | Probable (3) | Probable (3) |
| ***Significance*** | **33 (Medium)** | **33 (Medium)** |
| ***Status (positive or negative)*** | Negative | Positive |
| ***Reversibility*** | Irreversible | Irreversible |
| ***Irreplaceable loss of resources?*** | Yes | Partly |
| ***Can impacts be mitigated?*** | Yes, but only partial mitigation is possible. Valuable fossils may be lost in spite of management actions to mitigate such loss. | |
| ***Mitigation:***<br>» Monitoring of all construction-phase excavations by project staff and ECO.<br>» Inspection, sampling and recording of selected exposures in the event of fossil finds.<br>» Reports and fossils deposited in scientific institution. | | |
| ***Residual Impacts:*** It will never be possible to spot and rescue all fossils which means that there will always be some loss and therefore residual impact. This would be of unknown significance because of the sparse distribution of fossils in the broader landscape. Positive impacts would continue to be felt with successful mitigation because of the scientific implications of the resulting research opportunities. | | |

Measures for inclusion in the EMPr are as follows:

| | |
|---|---|
| **OBJECTIVE: To see and rescue fossil material that may be exposed in the excavations made for construction of the wind farm.** | |
| **Project component/s** | Turbine foundation excavations, trenches for cabling and infrastructure, spoil from excavations. |
| **Potential Impact** | Loss of fossils through going 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. | The developer, ECO and contractors. | Pre-construction. |
| Inform staff of the Fossil Finds Procedures to be followed in the event of fossil occurrences. | ECO/specialist. | Pre-construction. |
| Monitor for presence of fossils. | Contracted personnel and ECO. | Construction. |

| | | |
|---|---|---|
| Liaise with palaeontologist on nature of potential finds and appropriate actions. | ECO and specialist, SAHRA. | Construction. |
| Obtain a permit from SAHRA for the fossil finds collection should resources be discovered. | Developer/Specialist. | Construction |
| Excavate main finds, inspect pits and record and sample excavations. | Specialist. | Construction. |

| | |
|---|---|
| **Performance Indicator** | • Reporting of and liaison about possible fossil finds.<br>• Fossils noticed and rescued.<br>• Scientific record of fossil contexts and temporary exposures in earthworks. |
| **Monitoring** | • Ensure staff are aware of fossils and the procedure to follow when fossils are found.<br>• ECO to conduct inspections of open excavations whenever on site. |

## 7.2. Impacts to archaeological resources

Impacts to archaeological resources would occur only during the construction phase when foundations and cable trenches are excavated and land is cleared and levelled for access roads, laydown areas and ancillary infrastructure. The impacts would be direct since the excavations might damage or destroy archaeological materials. The probability of impacts occurring is highly probable, due to the turbine locations within a dune area where sites are likely to occur. The resultant significance of impacts is **Medium**. With mitigation the magnitude and probability of the impact would be reduced and the significance will be **Low**. There are no fatal flaws expected to occur on archaeological resources. The impact assessment summary for archaeological resources is shown in Table 4.

***Table 4:*** *Assessment of archaeological impacts.*

| ***Nature:*** ***Direct destruction of or damage to archaeological resources during excavation of foundations and trenches and during clearing of land for roads, laydown areas and ancillary infrastructure.*** | | |
|---|---|---|
| | **Without mitigation** | **With mitigation** |
| ***Extent*** | Local (2) | Local (1) |
| ***Duration*** | Permanent (5) | Permanent (5) |
| ***Magnitude*** | Low (4) | Minor (2) |
| ***Probability*** | Highly probable (4) | Improbable (2) |
| ***Significance*** | **44 (Medium)** | **16 (Low)** |
| ***Status (positive or negative)*** | Negative | Negative |
| ***Reversibility*** | Low | Low |
| ***Irreplaceable loss of resources?*** | Yes | Yes |
| ***Can impacts be mitigated?*** | Yes | |
| ***Mitigation:*** A walk down survey of all road alignments and the footprints of all turbines and other associated infrastructure must be undertaken and any mitigation still required should be effected prior to construction. | | |
| ***Residual Impacts:*** Entirely buried archaeological sites within the development footprint would likely be damaged or destroyed but the chances of significant buried sites being present in this landscape is deemed to be very low. Impacts to remaining materials after mitigation has been carried out at specific sites are insignificant. | | |

Measures for inclusion in the EMPr are as follows:

| OBJECTIVE: To ensure that impacts to archaeological sites and materials are minimised during construction of the wind farm. | |
|---|---|
| Project component/s | All infrastructure. |
| Potential Impact | Archaeological sites and materials may be damaged and/or destroyed during earthworks. |
| Activity/risk source | All earthworks and surface clearing. |
| Mitigation: Target/Objective | Successful location, evaluation and sampling of archaeological materials as required. |

| Mitigation: Action/control | Responsibility | Timeframe |
|---|---|---|
| Ensure that a preconstruction walk-down survey is carried out | Developer and Specialist. | Pre-construction - about 6 months before construction. |
| Obtain permits from SAHRA for any required mitigation, including excavation.. | Specialist. | Pre-construction - about 4-5 months before construction |
| Carry out mitigation excavations. | Specialist. | Pre-construction - about 3-4 months before construction. |

| | |
|---|---|
| Performance Indicator | • Successful completion of mitigation work.<br>• Negligible loss of significant known archaeological resources |
| Monitoring | None. |

### 7.3. Impacts to graves

Impacts on graves would occur only during the construction phase when foundations and cable trenches are excavated and land is cleared and levelled for access roads, laydown areas and ancillary infrastructure. The impacts would be direct since the excavations might damage or destroy graves. The probability of impacts occurring is very improbable with the resultant significance of impacts being **Low**. With mitigation the magnitude of the impact would be reduced but the significance remains **Low**. There are no fatal flaws for the development considering graves. The impact assessment summary for graves is shown in Table 5.

***Table 5:*** *Assessment of impacts to graves.*

| ***Nature: Direct destruction of or damage to graves during excavation of foundations and trenches and during the clearing of land for roads, laydown areas and ancillary infrastructure.*** | | |
|---|---|---|
| | **Without mitigation** | **With mitigation** |
| ***Extent*** | Local (1) | Local (1) |
| ***Duration*** | Permanent (5) | Permanent (5) |
| ***Magnitude*** | Very high (10) | Moderate (6) |
| ***Probability*** | Very improbable (1) | Very improbable (1) |
| ***Significance*** | **16 (Low)** | **12 (Low)** |
| ***Status (positive or negative)*** | Negative | Negative |
| ***Reversibility*** | Low | Low |
| ***Irreplaceable loss of resources?*** | Yes | Yes |
| ***Can impacts be mitigated?*** | Yes | |
| ***Mitigation:*** Rescue of any graves found during construction. | | |
| ***Residual Impacts:*** There may still be graves that are not seen during earthworks and that get lost entirely. | | |

Measures for inclusion in the EMPr are as follows:

| OBJECTIVE: To ensure that graves are rescued during construction of the wind farm. | |
|---|---|
| **Project component/s** | All infrastructure. |
| **Potential Impact** | Graves may be damaged and/or destroyed during earthworks. |
| **Activity/risk source** | All earthworks and surface clearing. |
| **Mitigation: Target/Objective** | Successful location, evaluation and rescue as required. |

| Mitigation: Action/control | Responsibility | Timeframe |
|---|---|---|
| Ensure that any graves found are immediately protected *in situ* and reported to an archaeologist or SAHRA. | ECO and project staff. | Immediately on discovery of grave. |
| Obtain permit from SAHRA for exhumation of remains. | Specialist. | Immediately on discovery of grave. |
| Carry out exhumation and recording of grave. | Specialist. | As soon as permit is approved. |

| | |
|---|---|
| **Performance Indicator** | Successful rescue of burials. |
| **Monitoring** | None. |

## 7.4. Impacts to the cultural landscape

This section does not include the precolonial cultural landscape which is effectively covered by Section 7.1 dealing with archaeology. Impacts to the cultural landscape would occur during all phases of the proposed project. Impacts would arise due to the presence in the landscape of incompatible features – especially the very large wind turbines and cranes required for their erection – and from the clearing of natural vegetation and transformation of the natural land surface. The impacts would be direct and occur both through the destruction of elements of the natural landscape such as vegetation and dunes and through contextual impacts where the visual qualities of the landscape deteriorate as a result of the presence of incompatible infrastructure and equipment. If the Wind Farm is built then the impacts will definitely occur and the resultant significance of impacts would be of **medium** significance. With mitigation the magnitude of the impact would be reduced slightly but the significance remains **medium**. Due to the fact that the area has been assessed and identified as being suitable for renewable energy development and wind farms can be expected to occur here, there are no fatal flaws in terms of the cultural landscape. The impact assessment summary for archaeology is shown in Table 6.

***Table 6:*** *Assessment of cultural landscape impacts.*

| ***Nature: Direct impacts to the landscape through the introduction of generally incompatible electrical infrastructure (turbines and substation).*** | | |
|---|---|---|
| | **Without mitigation** | **With mitigation** |
| ***Extent*** | Local (3) | Local (3) |
| ***Duration*** | Long-term (4) | Long-term (4) |
| ***Magnitude*** | Moderate (5) | Low (4) |
| ***Probability*** | Definite (5) | Definite (5) |
| ***Significance*** | **60 (Medium)** | **55 (Medium)** |
| ***Status (positive or negative)*** | Negative | Negative |
| ***Reversibility*** | High | High |
| ***Irreplaceable loss of resources?*** | No | No |

| | | |
|---|---|---|
| ***Can impacts be mitigated?*** | Not fully | |
| ***Mitigation:*** Mitigation measures should include rehabilitation of any disturbed areas not in use during operation and any other measures as listed in the Visual Impact Assessment but due to the size of the structures such measures would have minimal effect on the impact ratings. | | |
| ***Residual Impacts:*** Regardless of mitigation measures, the wind farm will still be visible in the cultural landscape and therefore create an impact. | | |

Measures for inclusion in the EMPr should be as specified by the visual assessment practitioner.

### 7.5. Cumulative impacts

This section considers all cumulative impacts to heritage resources as mentioned in the preceding tables and that would occur through the development of multiple renewable energy facilities in the area (Figure 39). The assessment is effectively an average of the negative and positive impacts related to each relevant type of heritage (Table 7).

Cumulative Impacts to palaeontology are likely to be of low significance because of the generally sparse distribution of fossils in the broader landscape. With mitigation the significance is reduced because of the positive aspect of rescuing scientific samples and the retrieval of data. Nevertheless, negative impacts will continue to accumulate when numerous projects commence with construction.

The development of many renewable energy projects in the area could result in the loss of many archaeological sites. Although data from coastal and near-coastal archaeological sites is sufficiently available, the loss of many sites further away from the coast where most renewable projects are planned (Figure 39) could result in significant cumulative impacts if no mitigation is carried out. It is also notable that the density of archaeological sites reduces away from the coast with impacts becoming consequently less likely. Although impacts to individual archaeological sites are still negative after mitigation, if many sites are sampled over multiple renewable energy projects then a positive cumulative impact could be realised because of the advance of scientific knowledge that may result from the mitigation work.

Because graves are very sparsely distributed, very few get impacted. This means that cumulative impacts are of low significance.

Several other wind farms have been proposed in the region but clustering of impacts is more desirable than spreading them widely from a cultural landscape perspective. Although cumulative impacts are likely to occur, having them concentrated reduces their significance. Also, the area is a declared REDZ which means that clustering of wind farms here will help reduce impacts in other areas and the associated cultural landscapes.

Overall the impacts to all heritage for the Namas Wind Farm alone are considered to be of medium significance (45), while impacts when considering all proposed projects would be slightly greater but still calculate to medium (60). Because of the diversity of heritage resources, the effectiveness of mitigation measures is likely to be variable with archaeology and graves being the easiest to successfully mitigate. Effective mitigation of palaeontology relies on the reporting of fossils found during earthworks, while it is impossible to hide the turbines in the landscape but a small degree of mitigation can be effected through application of best practice measures such as the rehabilitation of disturbed areas not required during operation.

***Table 7:*** *Assessment of cumulative heritage impacts.*

| ***Nature:*** ***Direct impacts to fossils, archaeology and graves during construction work and direct impacts to the landscape through the introduction of generally incompatible electrical infrastructure (turbines and substation).*** | | |
|---|---|---|
| | **Overall impact of the proposed project considered in isolation** | **Cumulative impact of the project and other projects in the area** |
| ***Extent*** | Local (2) | Local (3) |
| ***Duration*** | Long-term (4) | Long-term (4) |
| ***Magnitude*** | Low (3) | Moderate (5) |
| ***Probability*** | Definite (5) | Definite (5) |
| ***Significance*** | **45 (Medium)** | **60 (Medium)** |
| ***Status (positive or negative)*** | Negative (but with some positive aspects after mitigation) | Negative (but with some positive aspects after mitigation) |
| ***Reversibility*** | Low for some aspects and high for others | Low for some aspects and high for others |
| ***Irreplaceable loss of resources?*** | Yes for some aspects and no for others | Yes for some aspects and no for others |
| ***Can impacts be mitigated?*** | Yes for some aspects and no for others | |
| ***Mitigation:*** Mitigation measures are as per the individual types of heritage assessed above. Such measures should be applied at all renewable energy facilities. | | |
| ***Residual Impacts:*** Residual impacts are as per the individual types of heritage assessed above. They would apply equally to all renewable energy projects. | | |

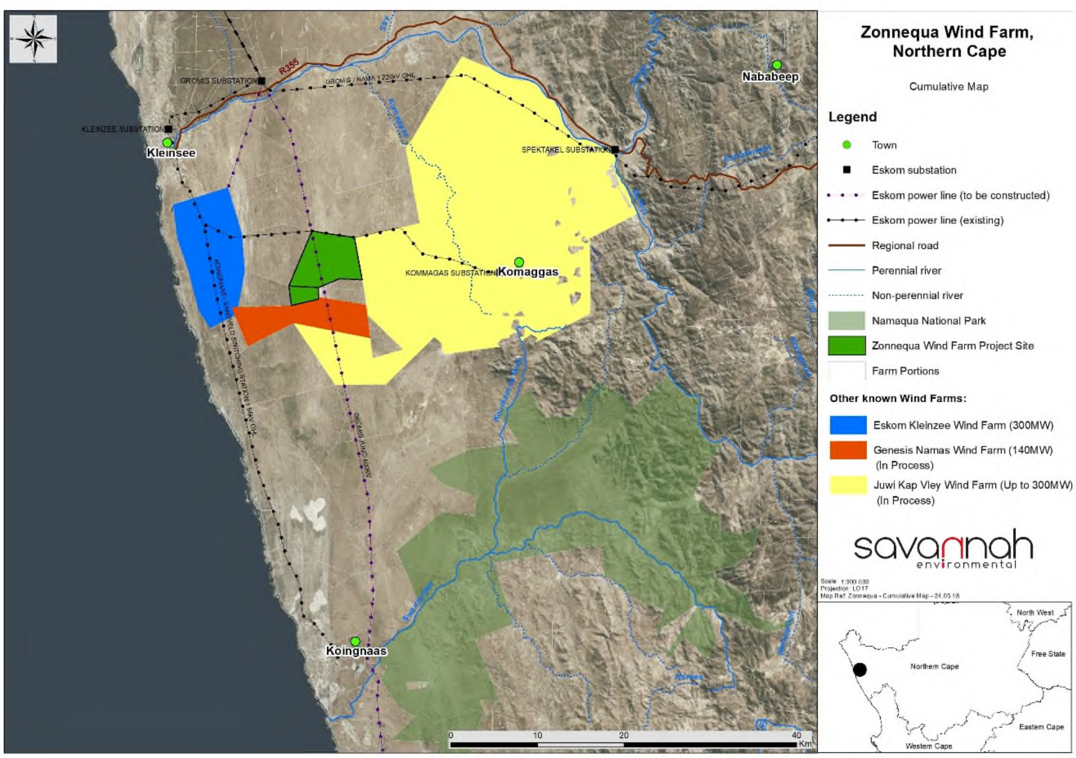

***Figure 19:*** *Map showing other proposed and authorised renewable energy facilities in the Kleinsee-Kommaggas area. The Eskom Kleinsee Wind Farm is the only facility to receive authorisation to date, the other facilities are still in process.*

### 7.6. Existing impacts to heritage resources

The study area is currently used for small livestock grazing (including sheep farming) and they walk over archaeological sites which results in trampling and displacement of archaeological materials. This leads to a very slow degradation in the scientific value and significance of the archaeological sites present. The cultural landscape has been impacted by mining activities but none occur in close proximity to the study area.

### 7.7. Levels of acceptable change

Any impact to an archaeological or palaeontological resource or a grave is deemed unacceptable until such time that the resource has been inspected and studied further if necessary. Impacts to the landscape are difficult to quantify but in general a development that visually dominates the landscape from many vantage point is undesirable. Because of the height of the majority of the proposed development, such an impact is unavoidable but can be tolerated because it is reversible. The landscape to the north has already been considerably altered by mining in the past.

From the cumulative perspective, large numbers of archaeological sites have been lost to mining in the area but with the implementation of mitigation projects scientific knowledge regarding the prehistory of the area has advanced considerably. Overall, so long as the vast majority of sites do get found and are rescued then this impact would be deemed acceptable.

## 8. EVALUATION OF IMPACTS RELATIVE TO SUSTAINABLE SOCIAL AND ECONOMIC BENEFITS

Section 38(3)(d) of the NHRA requires an evaluation of the impacts on heritage resources relative to the sustainable social and economic benefits to be derived from the development. The project would provide energy to South Africa which is needed for economic development. It would also provide a number of construction phase jobs and a smaller number of longer term jobs during the operation phase. Because the impacts to heritage are manageable and can generally be mitigated it is considered that the social and economic benefits outweigh the impacts to heritage resources expected with the development of the Zonnequa Wind Farm.

## 9. CONCLUSIONS

Palaeontological and archaeological resources are the main concerns for this proposed development, although fossils are rather less likely to be found than archaeological sites. While fossils would be revealed by excavations during construction and would require reporting when found, archaeological sites will be readily located during a final pre-construction survey and can be rescued through archaeological excavation before construction starts. Because the study area falls within a REDZ, the development of renewable energy facilities is expected and such infrastructure will be clustered in the area. There are no fatal flaws and the development is acceptable from a heritage perspective, subject to the implementation of the recommended mitigation measures. Buffers around known archaeological sites have been respected (Figure A3.6 & A3.7) and no further buffers require implementation. Considering the reasoned opinion of the specialist included above, the project can be authorised from a heritage perspective.

# 10. RECOMMENDATIONS

Because impacts are not of high significance and can easily be managed, it is recommended that the proposed wind farm and associated infrastructure should be authorised but subject to the following conditions which should be included in the conditions of authorisation:

- An archaeologist should be appointed to conduct a final pre-construction survey of the approved layout at least 6 months prior to commencement of construction;
- A chance finds procedure must be implemented for the rescuing of any fossils discovered during construction;
- All work is to be carried out within the authorised construction footprint. Any new areas that may need to be disturbed must be surveyed for archaeological sites prior to disturbance;
- Where possible, built elements should be painted in a colour to match the surrounding landscape;
- Any disturbed areas not required during operation must be rehabilitated after construction; and
- If any archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

# 11. REFERENCES

Deacon, H.J. 2004. Specialist report Heritage Impact Assessment Kornavlei Prospecting, near Komaggas, Northern Cape. Unpublished report for Site Plan Consulting.

Dewar, G. 2008. *The archaeology of the coastal desert of Namaqualand, South Africa: a regional synthesis*. Oxford: British Archaeological Reports International Series 1761.

Dreyer, C. 2002. Archaeological assessment of the proposed upgrading of the road (DR2955) between Springbok and Komaggas, Northern Cape. Unpublished report for Cebo Environmental Consultants.

Halkett, D. 2002. An analysis of a randomly collected Early Stone Age artefact assemblage from the Sandkop mining area, Kleinzee, Namaqualand. Unpublished report prepared for De Beers Namaqualand Mines. University of Cape Town: Archaeology Contracts Office.

Halkett, D. J. & Hart, T. J. G. 1997. An archaeological assessment of the coastal strip, and a proposed heritage management plan for: De Beers Namaqualand Mines. Unpublished report prepared for De Beers Consolidated Mines NM. University of Cape Town: Archaeology Contracts Office.

Hart, T.J.G. & Halkett, D. 1994. Report on Phase 2 archaeological excavations at the Namakwasands project (first phase) Vredendal District Namaqualand. Unpublished report prepared for Namakwa Sands Ltd. University of Cape Town: Archaeology Contracts Office.

Jerardino, A.M., Yates, R., Morris, A.G. & Sealy, J.C. 1992. A dated human burial from the Namaqualand coast: observations on culture, biology and diet. *South African Archaeological Bulletin* 47: 75–81.

Magoma, M. 2016. Phase 1 Archaeological and Cultural Heritage Impact Assessment specialist report for the proposed 400kV power line from the existing Eskom Juno substation to the existing Gromis substation in the Western and Northern Cape Provinces respectively. Unpublished report for Eskom Holdings Ltd.

Morris, D. & Webley, L. 2004. Cultural History in and adjacent the Namaqua National Park. Unpublished SANParks report.

Nienaber, G.S. & Raper, P.E. 1977. *Toponymica Hottentotica*. Naamkunderrks Nr 7. Raad vir Geesteswetenskaplike Navorsing: Pretoria.

Orton, J. 2012. Late Holocene Archaeology in Namaqualand, South Africa: hunter-gatherers and herders in a semi-arid environment. Unpublished D.Phil. thesis: University of Oxford.

Orton, J. 2013. Geometric rock art in Western South Africa and its implications for the spread of early herding. *South African Archaeological Bulletin* 68: 27-40.

Orton, J. 2015. The introduction of pastoralism to southernmost Africa: thoughts on new contributions to an ongoing debate. *Azania: Archaeological Research in Africa* 50: 250-258.

Orton, J. 2016. Prehistoric cultural landscapes in South Africa: a typology and discussion. *South African Archaeological Bulletin* 71: 119-129.

Orton, J. 2017. Archaeological mitigation at the Tronox Namakwa Sands Mine, Vredendal Magisterial District, Western Cape. Unpublished report prepared for Tronox Mineral Sands (Pty) Ltd. Lakeside: ASHA Consulting (Pty) Ltd.

Orton, J. 2018. Heritage Impact Assessment: Scoping and Environmental Impact Assessment for the proposed Kap Vley Wind Energy Facility, Namakwaland Magisterial District, Northern Cape Province: EIA Phase Report. Unpublished report prepared for CSIR. Lakeside: ASHA Consulting (Pty) Ltd.

Orton, J. & Halkett, D. 2005. A report on the archaeological mitigation program at De Beers Namaqualand Mines, August to September 2004. Unpublished report prepared for De Beers Consolidated Mines NM. University of Cape Town: Archaeology Contracts Office.

Orton, J. & Webley, L. 2012a. Heritage impact assessment for the proposed ESKOM Kleinsee Wind Energy Facility, Namakwaland Magisterial District, Northern Cape. Unpublished report prepared for Savannah Environmental (Pty) Ltd. Diep River: ACO Associates cc.

Orton, J. & Webley, L. 2012b. Heritage impact assessment for the proposed Project Blue Wind Energy Facility, Kleinzee, Namakwa Magisterial District, Northern Cape. Unpublished report prepared for Savannah Environmental (Pty) Ltd. Diep River: ACO Associates cc.

Pether, J. 2017. Brief palaeontological assessment (desktop study) Proposed Kap Vley Wind Energy Facility Namakwa District Municipality, Northern Cape. Kap Vley 315, Gra' Water 331, Kamaggas 200. Unpublished report prepared for ASHA Consulting (Pty) Ltd. Kommetjie: John Pether.

Raper, P.E. n.d. Dictionary of southern African place names. Accessed online at https://archive.org/stream/DictionaryOfSouthernAfricanPlaceNames/SaPlaceNames_djvu.txt on 19 June 2015.

Rebelo, E. 2003. Namaqualand Mine, Northern Cape. Mining Weekly 13 March 2003. Accessed online at: http://www.miningweekly.com/print-version/namaqualand-mine-northern-cape-2003-03-13 on 27th August 2017.

SAHRA. 2007. Minimum Standards: archaeological and palaeontological components of impact assessment reports. Document produced by the South African Heritage Resources Agency, May 2007.

Schaeffer, A. 2008. *Life and travels in the northwest 1850-1899: Namaqualand, Bushmanland & West Coast*. Cape Town: Yoshi Publishing.

Van Pletzen-Vos, L. & Rust, R. 2011. Phase 1 Archaeological Impact Assessment Portion 5, Farm Kamaggas No 200, Proposed Nama Khoi Cemetery. Unpublished report for PHS Consulting.

Webley, L. 1986. Pastoralist ethnoarchaeology in Namaqualand. In: Hall, M. & Smith, A.B. (eds) Prehistoric pastoralism in southern Africa. *South African Archaeological Society Goodwin Series* 5: 57–61.

Webley, L. 1992. The history and archaeology of pastoralist and hunter-gatherer settlement in the north-western Cape, South Africa. Unpublished PhD thesis: University of Cape Town.

Webley, L. 2002. The re-excavation of Spoegrivier Cave on the West Coast of South Africa. *Annals of the Eastern Cape Museums* 2: 19–49.

Webley, L. 2007. Archaeological evidence for pastoralist land-use and settlement in Namaqualand over the last 2000 years. *Journal of Arid Environments* 70: 629–640.

Webley, L. & Halkett, D. 2010. Archaeological Impact Assessment: Proposed prospecting on Portion 2 and Remainder Portion of the Farm Zankopsdrift 537, Garies, Northern Cape. Unpublished report for Sedex Minerals Pty Ltd. University of Cape Town: Archaeology Contracts Office.

# APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

## Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

***Contact Details and personal information:***

**Address:** 40 Brassie Street, Lakeside, 7945
**Telephone:** (021) 788 8425
**Cell Phone:** 083 272 3225
**Email:** jayson@asha-consulting.co.za

**Birth date and place:** 22 June 1976, Cape Town, South Africa
**Citizenship:** South African
**ID no:** 760622 522 4085
**Driver's License:** Code 08
**Marital Status:** Married to Carol Orton
**Languages spoken:** English and Afrikaans

***Education:***

| | | |
|---|---|---|
| SA College High School | Matric | 1994 |
| University of Cape Town | B.A. (Archaeology, Environmental & Geographical Science) | 1997 |
| University of Cape Town | B.A. (Honours) (Archaeology)* | 1998 |
| University of Cape Town | M.A. (Archaeology) | 2004 |
| University of Oxford | D.Phil. (Archaeology) | 2013 |

*Frank Schweitzer memorial book prize for an outstanding student and the degree in the First Class.

***Employment History:***

| | | |
|---|---|---|
| Spatial Archaeology Research Unit, UCT | Research assistant | Jan 1996 – Dec 1998 |
| Department of Archaeology, UCT | Field archaeologist | Jan 1998 – Dec 1998 |
| UCT Archaeology Contracts Office | Field archaeologist | Jan 1999 – May 2004 |
| UCT Archaeology Contracts Office | Heritage & archaeological consultant | Jun 2004 – May 2012 |
| School of Archaeology, University of Oxford | Undergraduate Tutor | Oct 2008 – Dec 2008 |
| ACO Associates cc | Associate, Heritage & archaeological consultant | Jan 2011 – Dec 2013 |
| ASHA Consulting (Pty) Ltd | Director, Heritage & archaeological consultant | Jan 2014 – |

***Professional Accreditation:***

Association of Southern African Professional Archaeologists (ASAPA) membership number: 233
CRM Section member with the following accreditation:

- Principal Investigator: Coastal shell middens (awarded 2007)
  Stone Age archaeology (awarded 2007)
  Grave relocation (awarded 2014)
- Field Director: Rock art (awarded 2007)
  Colonial period archaeology (awarded 2007)

Association of Professional Heritage Practitioners (APHP) membership number: 43

- Accredited Professional Heritage Practitioner

## ➢ *Memberships and affiliations:*

| | |
|---|---|
| South African Archaeological Society Council member | 2004 – 2016 |
| Assoc. Southern African Professional Archaeologists (ASAPA) member | 2006 – |
| UCT Department of Archaeology Research Associate | 2013 – |
| Heritage Western Cape APM Committee member | 2013 – |
| UNISA Department of Archaeology and Anthropology Research Fellow | 2014 – |
| Fish Hoek Valley Historical Association | 2014 – |
| Kalk Bay Historical Association | 2016 – |
| Association of Professional Heritage Practitioners member | 2016 – |

## *Fieldwork and project experience:*

Extensive fieldwork and experience as both Field Director and Principle Investigator throughout the Western and Northern Cape, and also in the western parts of the Free State and Eastern Cape as follows:

Feasibility studies:

- Heritage feasibility studies examining all aspects of heritage from the desktop

Phase 1 surveys and impact assessments:

- Project types
  - Notification of Intent to Develop applications (for Heritage Western Cape)
  - Desktop-based Letter of Exemption (for the South African Heritage Resources Agency)
  - Heritage Impact Assessments (largely in the Environmental Impact Assessment or Basic Assessment context under NEMA and Section 38(8) of the NHRA, but also self-standing assessments under Section 38(1) of the NHRA)
  - Archaeological specialist studies
  - Phase 1 archaeological test excavations in historical and prehistoric sites
  - Archaeological research projects
- Development types
  - Mining and borrow pits
  - Roads (new and upgrades)
  - Residential, commercial and industrial development
  - Dams and pipe lines
  - Power lines and substations
  - Renewable energy facilities (wind energy, solar energy and hydro-electric facilities)

Phase 2 mitigation and research excavations:

- ESA open sites
  - Duinefontein, Gouda, Namaqualand
- MSA rock shelters
  - Fish Hoek, Yzerfontein, Cederberg, Namaqualand
- MSA open sites
  - Swartland, Bushmanland, Namaqualand
- LSA rock shelters
  - Cederberg, Namaqualand, Bushmanland
- LSA open sites (inland)
  - Swartland, Franschhoek, Namaqualand, Bushmanland
- LSA coastal shell middens
  - Melkbosstrand, Yzerfontein, Saldanha Bay, Paternoster, Dwarskersbos, Infanta, Knysna, Namaqualand
- LSA burials
  - Melkbosstrand, Saldanha Bay, Namaqualand, Knysna
- Historical sites
  - Franschhoek (farmstead and well), Waterfront (fort, dump and well), Noordhoek (cottage), variety of small excavations in central Cape Town and surrounding suburbs
- Historic burial grounds
  - Green Point (Prestwich Street), V&A Waterfront (Marina Residential), Paarl

## *Awards:*

Western Cape Government Cultural Affairs Awards 2015/2016: Best Heritage Project.

# APPENDIX 2: PALAEONTOLOGICAL SPECIALIST STUDY

**PALAEONTOLOGICAL IMPACT ASSESSMENT**
**(DESKTOP STUDY)**

**PROPOSED GENESIS NAMAS AND ZONNEQUA WIND FARMS**
**NAMAKWA DISTRICT MUNICIPALITY, NORTHERN CAPE**

**By**

**John Pether, M.Sc., Pr. Sci. Nat. (Earth Sci.)**
**Geological and Palaeontological Consultant**
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**Prepared at the Request of**

**ASHA Consulting (Pty) Ltd**
Tel: (021) 789 0327 | 083 272 3225
Email: jayson@asha-consulting.co.za

FINAL VERSION
**3 September 2018**

**EXECUTIVE SUMMARY**

**1. Site Names**

Genesis Namas Wind (Pty) Ltd (Namas Wind Farm) and Genesis Zonnequa Wind (Pty) Ltd. (Zonnequa Wind Farm).

**2. Location**

The proposed wind farms are located about 20 km southeast of Kleinsee in the Nama Khoi Local Municipality, Namakwa District Municipality, Northern Cape Province (Figure 1). The properties involved are:

Namas Wind Farm: Rooivlei 3/327 and RE/327; Zonnekwa 3/328 and 4/328.

Zonnequa Wind Farm: Zonnekwa RE/326; Zonnekwa 1/328.

Wind Farms mapsheets: 2917CC BRAZIL and 2917CD KOMAGGAS.

Power line corridor mapsheet: 2916DB & 2917CA KLEINSEE.

**3. Locality Plan**

See Figure 2.

**4. Proposed Development**

The proposed Namas Wind Farm involves up to 43 wind turbines, and up to 56 turbines are envisaged for the Zonnequa Wind Farm (Figure 2). Concomitant infrastructure entails access roads, construction laydown areas, cabling trenches, control stations, workshop and offices. The power lines to the ESKOM grid are intended to proceed along the existing ESKOM Gromis-Juno corridor to the Gromis substation (Figure 1) (the 400kV Gromis-Juno power line has been authorised and will be constructed within the near future). The power lines for the wind farms are assessed as 300m power line corridors. Each facility will have its own power line to connect to the grid.

**5. Palaeontological Heritage Resources Identified**

The affected surficial formations include early to mid-Holocene dunes of the **Hardevlei Formation** and earlier late Quaternary coversands of the **Koekenaap Formation**. Beneath these unconsolidated sands are compact, pedogenically-altered aeolianites termed "**Dorbank Formations**" which are fossil dune plumes of later mid-Quaternary age. An older dorbank dune plume underlies the eastern part of the Project Area; a later dorbank dune plume underlies the western part where most of the turbines will be situated (Figures 2 to 6). Between these dune plume ridges is a non-depositional area which is closely underlain by pale pedocrete which is likely to have formed in early mid-Quaternary aeolianites equivalent to the **Olifantsrivier Formation**.

**6. Anticipated Impacts**

The primary palaeontological concern is the fossil bones that are sparsely distributed in these aeolian deposits. Although sparse in aeolian Dorbank formations and overlying coversands and dunes, they are of high scientific value and important for palaeoclimatic, palaeobiological and biostratigraphic studies. The fossil material in these deposits is a sample of the middle and late Quaternary fauna of the Namaqualand coast.

The dimensions of the wind turbine foundation slabs are 20 X 20 X 3 m. There will be a considerable number of them (~99) distributed over and "sampling" a wide area. Therefore, in spite of the overall low fossil potential, there is a distinct possibility that buried palaeosurfaces bearing fossil bones and archaeological material may be exposed in some of the excavations.

The excavations for cabling and other infrastructure are shallow and mainly affect the coversands, but the cabling trenches will traverse considerable lengths across the Project Area and intersect the locally-fossiliferous top of the Dorbank Unit in places. The footings of the transmission line pylons that connect to the grid are likely to be minor in scale and have a low likelihood of impact, although not altogether absent.

| **NATURE OF IMPACT SUMMARY** | | |
|---|---|---|
| | **Without mitigation** | **With mitigation** |
| **Significance** | Medium | Medium |
| **Status** | Negative | Positive |
| **Reversibility** | Irreversible | Irreversible |
| **Irreplaceable loss of resources?** | Yes | Partly |
| **Can impacts be mitigated?** | Yes, but only partial mitigation is possible. Valuable fossils may be lost in spite of management actions to mitigate such loss. | |
| **Mitigation:** | • Monitoring of all construction-phase excavations.<br>• Inspection, sampling and recording of selected exposures in the event of fossil finds.<br>• Fossil finds and contextual reports deposited in a curatorial scientific institution. | |
| **Cumulative impact** | • The inevitable and permanent loss of fossils. | |

## 7. Recommendations

The Medium/moderate level of significance indicates that the palaeontological impact does not greatly influence the decision to develop the area, but appropriate mitigation measures are required. Therefore, the development of the wind farms within the project sites is considered to be acceptable from a palaeontological perspective and can be authorised, subject to the implementation of the recommended mitigation measures. It is recommended that a requirement to be alert for possible fossils and buried archaeological material be included in the EMPr for the Construction Phase of the proposed Namas and Zonnequa Wind Farms and Powerlines, with a Fossil Finds Procedure (Appendix 3) in place.

The field supervisor/foreman and workers involved in digging excavations must be informed of the need to look out for fossils and buried potential archaeological material. Workers seeing potential objects are to cease work at that spot and to report to the field supervisor who, in turn, will report to the Environmental Control Officer (ECO). The ECO will inform the developer and contact the palaeontologist contracted to be on standby in the case of fossil finds.  The latter will liaise with SAHRA on the nature of the find and consequent actions (permitting and collection of find).

If palaeontological mitigation is applied to this project as recommended, it is possible that these developments will to some extent alleviate the negative cumulative impact on paleontological resources in the region.  The history of these vast tracts of sands, gravels and pedocretes of the Northern Cape is very poorly known, with very few fossils to rely on.  Therefore, though of low probability, any find will be of considerable importance and could possibly add to the scientific knowledge of the area in a positive manner.

**DECLARATION OF INDEPENDENCE**

PALAEONTOLOGICAL IMPACT ASSESSMENT REPORT (Desktop Study).
PROPOSED GENESIS NAMAS AND ZONNEQUA WIND FARMS, NAMAKWA DISTRICT MUNICIPALITY, NORTHERN CAPE.

**Terms of Reference**

This assessment forms part of the Heritage Impact Assessment and it assesses the overall palaeontological (fossil) sensitivities of formations underlying the Project Area in terms of the proposed development.

**Declaration**

I …**John Pether**……, as the appointed independent specialist hereby declare that I:

» act/ed as the independent specialist in the compilation of the above report;
» regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
» do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
» have and will not have any vested interest in the proposed activity proceeding;
» have disclosed to the EAP any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management act;
» have provided the EAP with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
» am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.

Signature of the specialist

Date: 3 September 2018

**CURRICULUM VITAE**

**John Pether, M.Sc., Pr. Sci. Nat. (Earth Sci.)**

Independent Consultant/Researcher recognized as an authority with 37 years' experience in the field of coastal-plain and continental-shelf palaeoenvironments, fossils and stratigraphy, mainly involving the West Coast/Shelf of southern Africa. Has been previously employed in academia (South African Museum) and industry (Trans Hex, De Beers Marine). At present an important involvement is in Palaeontological Impact Assessments (PIAs) and mitigation projects in terms of the National Heritage Resources Act 25 (1999) (~250 PIA reports to date) and is an accredited member of the Association of Professional Heritage Practitioners (APHP). Continues to be involved as consultant to offshore and onshore marine diamond exploration ventures. Expertise includes:

- Coastal plain and shelf stratigraphy (interpretation of open-pit exposures, on/offshore cores and exploration drilling).
- Sedimentology and palaeoenvironmental interpretation of shallow marine, aeolian and other terrestrial surficial deposits.
- Marine macrofossil taxonomy (molluscs, barnacles, brachiopods) and biostratigraphy.
- Marine macrofossil taphonomy.
- Sedimentological and palaeontological field techniques in open-cast mines (including finding and excavation of vertebrate fossils (bones).

**Membership of Professional Bodies**

- South African Council of Natural Scientific Professions. Earth Science. Reg. No. 400094/95.
- Geological Society of South Africa.
- Palaeontological Society of Southern Africa.
- Southern African Society for Quaternary Research.
- Association of Professional Heritage Practitioners (APHP), Western Cape. Accredited Member No. 48.

**Past Clients Palaeontological Assessments**

| | |
|---|---|
| AECOM SA (Pty) Ltd. | Guillaume Nel. Env. Management Consultants. |
| Agency for Cultural Resource Management (ACRM). | Klomp Group. |
| AMATHEMBA Environmental. | Megan Anderson, Landscape Architect. |
| Anél Blignaut Environmental Consultants. | Ninham Shand (Pty) Ltd. |
| Arcus Gibb (Pty) Ltd. | PD Naidoo & Associates (Pty) Ltd. |
| ASHA Consulting (Pty) Ltd. | Perception Environmental Planning. |
| Aurecon SA (Pty) Ltd. | PHS Consulting. |
| BKS (Pty) Ltd. Engineering and Management. | Resource Management Services. |
| Bridgette O'Donoghue Heritage Consultant. | Robin Ellis, Heritage Impact Assessor. |
| Cape Archaeology, Dr Mary Patrick. | Savannah Environmental (Pty) Ltd. |
| Cape EAPrac. | Sharples Environmental Services cc |
| CCA Environmental (Pty) Ltd. | Site Plan Consulting (Pty) Ltd. |
| Centre for Heritage & Archaeological Resource Management | Strategic Environmental Focus (Pty) Ltd. |
| Chand Environmental Consultants. | UCT Archaeology Contracts Office (ACO). |
| CK Rumboll & Partners. | UCT Environmental Evaluation Unit |
| CNdV Africa | Urban Dynamics. |
| CSIR - Environmental Management Services. | Van Zyl Environmental Consultants |
| Digby Wells & Associates (Pty) Ltd. | ENVIRO DINAMIK. |
| Enviro Logic | Wethu Investment Group Ltd. |
| Environmental Resources Management SA (ERM). | Withers Environmental Consultants. |
| Greenmined Environmental | |

**Stratigraphic consulting including palaeontology**

| | |
|---|---|
| Afri-Can Marine Minerals Corp | Council for Geoscience |
| De Beers Marine (SA) Pty Ltd. | De Beers Namaqualand Mines. |
| Geological Survey Namibia | IZIKO South African Museum. |
| Namakwa Sands (Pty) Ltd | NAMDEB |

**CONTENTS**

**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.

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

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.

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.

Clast: Fragments of pre-existing rocks, *e.g*. sand grains, pebbles, boulders, produced by weathering and erosion. Clastic – composed of clasts.

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.

Conglomerate: A cemented gravel deposit.

Coversands: Aeolian blanket deposits of sandsheets and smaller dunes.

Duricrust: A general term for a zone of chemical precipitation and hardening formed at or near the surface of sedimentary bodies through pedogenic and (or) non-pedogenic processes. It is formed by the accumulation of soluble minerals deposited by mineral-bearing waters that move upward, downward, or laterally by capillary action, commonly assisted in arid settings by evaporation. Classified into calcrete, ferricrete, silcrete, gypcrete, sepiocrete etc.

Ferricrete: Indurated deposit (duricrust) consisting predominantly of accumulations of iron sesquioxides, with various dark-brown to yellow-brown hues. It may form by deposition from solution or as a residue after removal of silica and alkalis. Like calcrete it has pedogenic and groundwater forms. Synonyms are laterite, iron pan or "koffieklip".

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

Fm.: Formation.

Fossil: The remains of parts of animals and plants found in sedimentary deposits. Most commonly hard parts such as bones, teeth and shells which in lithified sedimentary rocks are usually altered by petrification (mineralization). Also impressions and mineral films in fine-grained sediments that preserve indications of soft parts. Fossils plants include coals, petrified wood and leaf impressions, as well as microscopic pollen and spores. Marine sediments contain a host of microfossils that reflect the plankton of the past and provide records of ocean changes. Nowadays also includes molecular fossils such as DNA and biogeochemicals such as oils and waxes.

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).

OSL: Optically stimulated luminescence. 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 formed on a palaeosurface. The soil 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 or pedocrete, but may be exhumed by erosion (*e.g*. wind erosion/deflation) or by bulk earth works.

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.*).

Pedocrete: A duricrust formed by pedogenic processes.

PIA: Palaeontological Impact Assessment.

Rhizolith: Fossil root. Most commonly formed by pedogenic carbonate deposition around the root and developed in palaeosols.

Sepiocrete: A duricrust with a high content of the magnesian clay mineral sepiolite.

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

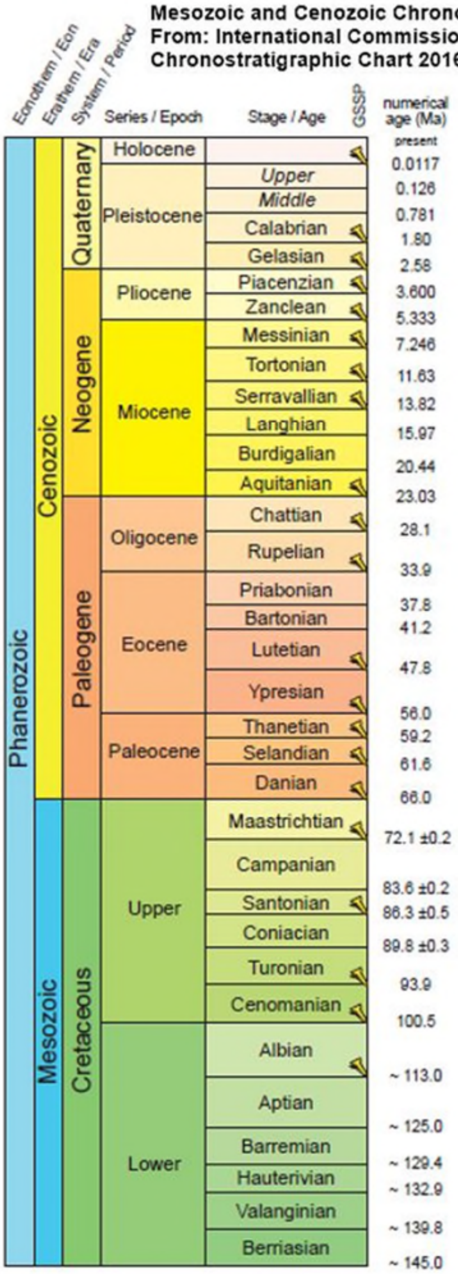
Stratotype locality: The place where deposits regarded as defining the characteristics of a particular geological formation occur.

Tectonic: Relating to the structure of the earth's crust and the large-scale processes which take place within it (faulting and earthquakes, crustal uplift or subsidence.

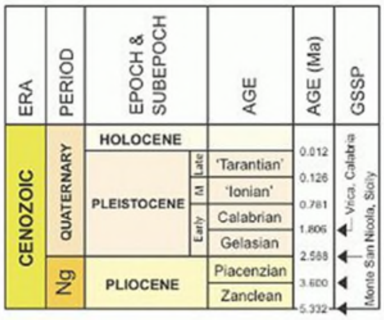
Trace fossil: A structure or impression in sediments that preserves the behaviour of an organism, such as burrows, borings and nests, feeding traces (sediment processing), farming structures for bacteria and fungi, locomotion burrows and trackways and traces of predation on hard parts (tooth marks on bones, borings into shells by predatory gastropods and octopuses).

## GEOLOGICAL TIME SCALE TERMS

**Mesozoic and Cenozoic Chronostratigraphy**
**From: International Commission on Stratigraphy.**
**Chronostratigraphic Chart 2016-12.pdf**




**ICS-approved 2009 Quaternary (SQS/INQUA) proposal**




Holocene: The most recent geological epoch commencing 11.7 ka till the present.

Pleistocene: Epoch from 2.6 Ma to 11.7 ka.
Late Pleistocene 11.7–126 ka.
Middle Pleistocene 135–781 ka.
Early Pleistocene 781–2588 ka.

Quaternary: The current Period, from 2.6 Ma to the present, in the Cenozoic Era.
The Quaternary includes both the Pleistocene and Holocene epochs. As used herein, early and middle Quaternary correspond with the Pleistocene divisions, but late Quaternary includes the Late Pleistocene and the Holocene.

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. Not used for durations not extending from the Present. For a duration only "kyr" is used.

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. Not used for durations not extending from the Present. For a duration only "Myr" is used.

For more detail see www.stratigraphy.org.

## 1 INTRODUCTION

Genesis Namas Wind (Pty) Ltd and Genesis Zonnequa Wind (Pty) Ltd propose to develop two adjacent Wind Energy Facilities (Wind Farms) on the coastal plain of Namaqualand in the Northern Cape, the names being the Namas Wind Farm and the Zonnequa Wind Farm respectively. ASHA Consulting (Pty) Ltd. has been appointed to carry out a Heritage Impact Assessment (HIA) for the proposed Wind Farms, of which this Palaeontological Impact Assessment report forms part. Its brief is to inform the developers of any palaeontological sensitivities within the proposed project sites, and the probability of fossils being uncovered in the subsurface and being disturbed or destroyed in the process of construction. This study has been undertaken from a desktop level and is considered to be sufficient for the area under assessment.

## 2 LOCATION

The proposed Wind Farms are located about 20 km southeast of Kleinsee in the Nama Khoi Local Municipality, Namakwa District Municipality, Northern Cape Province (Figure 1). The properties involved are listed below, as well as the properties traversed by the corridor for the power lines:

| Namas Wind Farm | Power line (from south to north) |
|---|---|
| Portion 3 of Farm Rooivlei 327<br>Remainder of farm Rooivlei 327<br>Portion 3 of Farm Zonnekwa 328<br>Portion 4 of Farm Zonnekwa 328 | Remainder of Farm Rooivlei 327<br>Portion 3 of Farm Zonnekwa 328<br>Portion 2 of Farm Zonnekwa 328<br>Portion 1 of Farm Zonnekwa 326<br>Remainder of Farm Zonnekwa 326<br>Remainder of Kannabieduin 324<br>Remainder of Sand Kop 322<br>Remainder of Farm Mannels Vley 321<br>Remainder of Farm Dikgat 195<br>Remainder of Farm Honde Vlei 325<br>Portion 15 of Farm Dikgat 195 |

| Zonnequa Wind Farm | Power line (from south to north) |
|---|---|
| Remainder of farm Zonnekwa 326<br>Portion 1 of Farm Zonnekwa 328 | Remainder of Farm Zonnekwa 326<br>Remainder of Kannabieduin 324<br>Remainder of Sand Kop 322<br>Remainder of Farm Mannels Vley 321<br>Remainder of Farm Dikgat 195<br>Remainder of Farm Honde Vlei 325<br>Portion 15 of Farm Dikgat 195 |

The relevant 1:50000 topo-cadastral maps are 2917CC BRAZIL and 2917CD KOMAGGAS for the proposed Wind Farms and 2916DB & 2917CA KLEINSEE for the power lines.

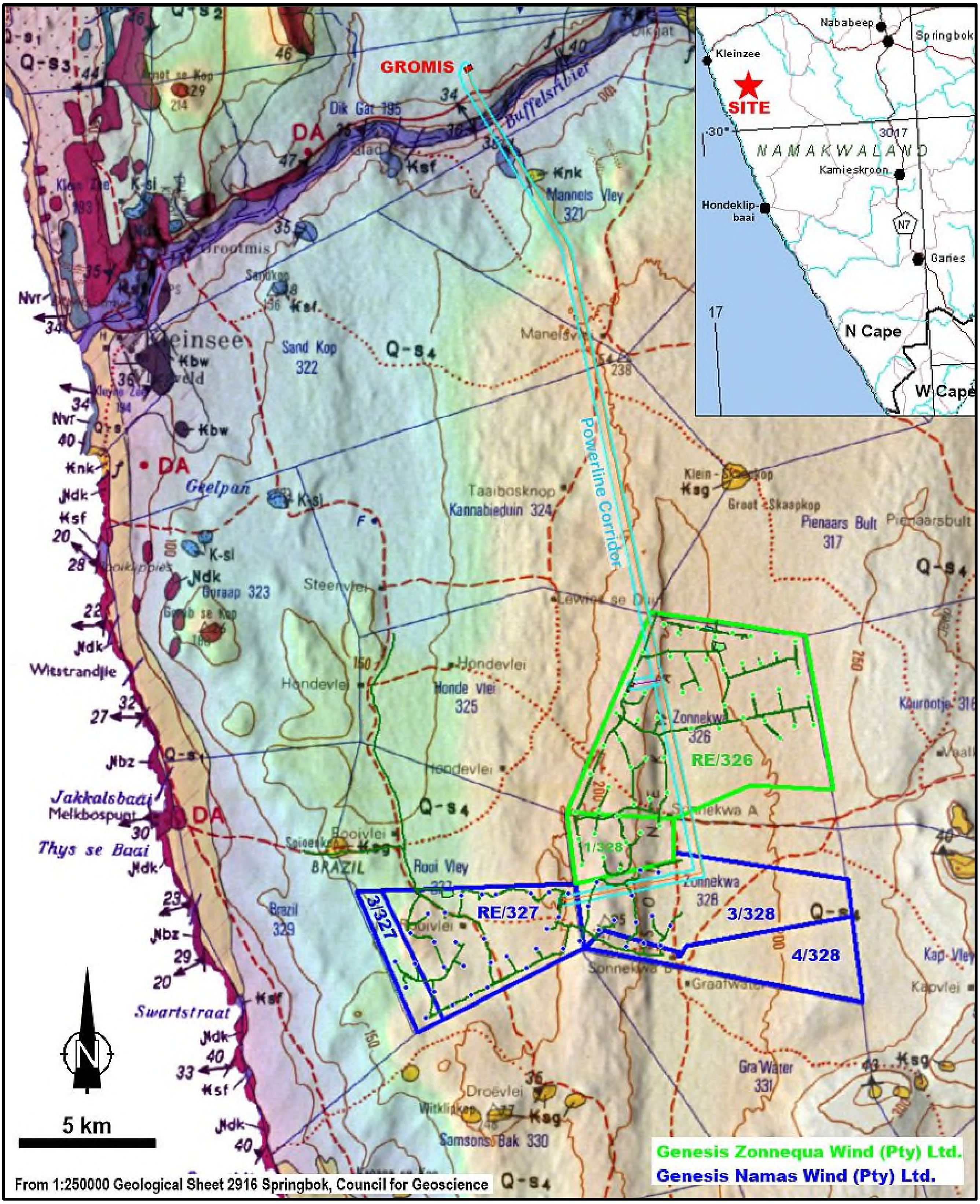



**Figure 1:** Location and Geology of the Project Area. Geological map with background shaded relief. Most of the coastal plain is covered by aeolian sands labelled as Q-s4.

## 3 LOCALITY PLAN

The proposed layouts of the wind turbines are shown in Figure 2 in which the surficial aeolian formations are annotated.

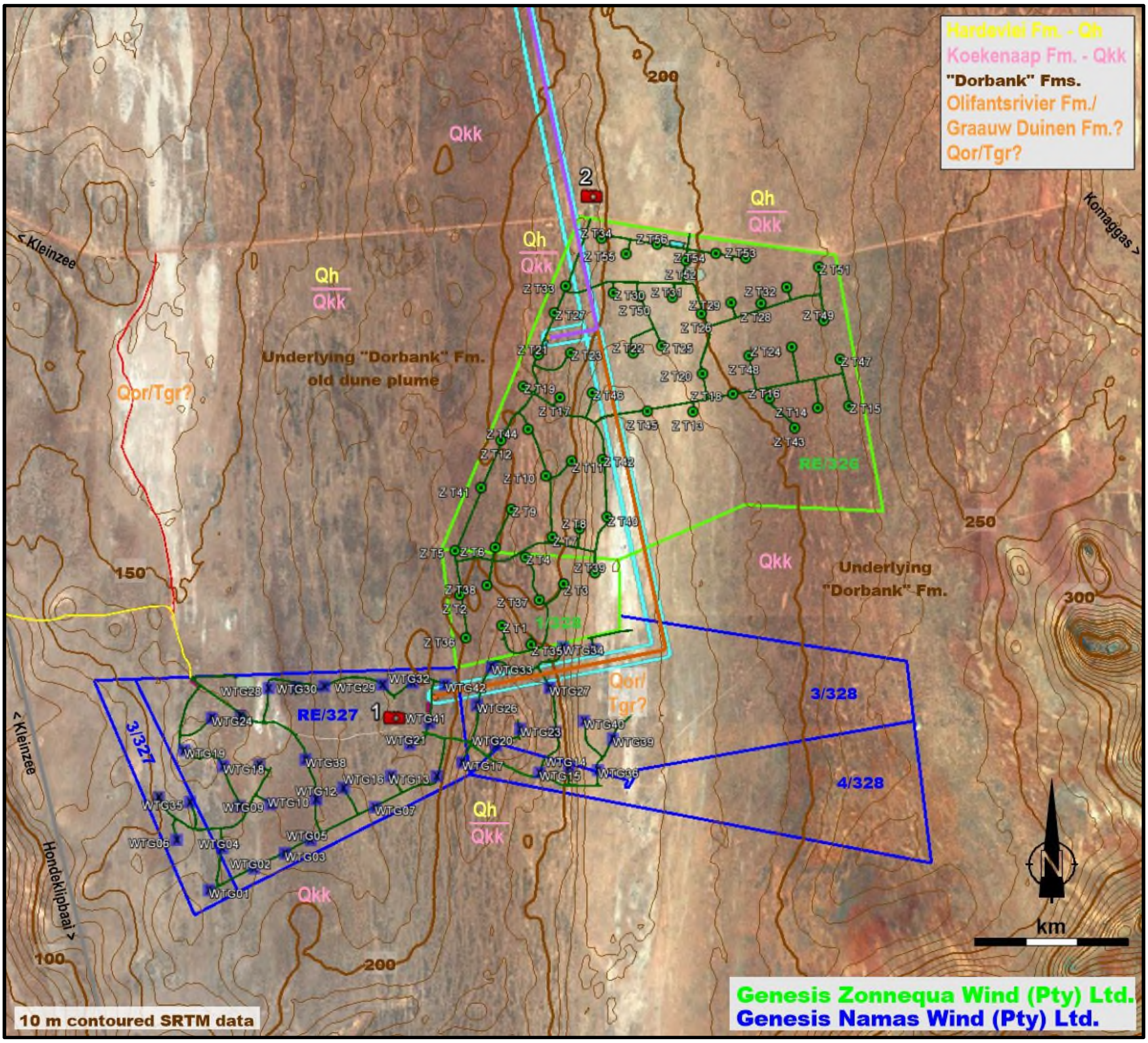



**Figure 2:** The proposed turbine layouts. Location of Figure 4 = 1; Figure 5 = 2. Due to the generalised nature of this report, the details of the turbines layouts do not substantially influence its findings.

## 4 PROPOSED DEVELOPMENT

The proposed Namas Wind Farm involves up to 43 wind turbines, and up to 56 turbines are envisaged for the Zonnequa Wind Farm (Figure 2). Concomitant infrastructure entails access roads, construction laydown areas, cabling trenches, control stations, workshop and offices. The power lines to the ESKOM grid are intended to proceed along the existing

ESKOM Gromis-Juno corridor to the Gromis substation (Figure 1) (the 400kV Gromis-Juno power line has been authorised and will be constructed within the near future). The power lines for the wind farms are assessed as 300m power line corridors. Each facility will have its own power line to connect to the grid.

## 5 PALAEONTOLOGICAL HERITAGE RESOURCES IDENTIFIED

### 5.1 Regional Geological History

The Project Area extends across the sandy coastal plain between elevations of ~150-230 m asl. A sense of the underlying bedrock topography in the wider area is imparted by outcrops on gentle eminences and hills. These are quartzites of the **Springbok Formation** (Bushmanland Group, Khurisberg Subgroup) (Figure 1, Ksg), which are altered, very ancient sediments approximately 1600 Ma (Ma = million years old) (Marais *et al*., 2001). There are no fossils in these rocks.

At times during the late Cretaceous and Palaeogene periods this higher part of the coastal plain was occupied by the sea during times of global warming, polar icecap melting and high sea levels, but marine deposits from these times have evidently been eroded away, or remain as undiscovered residual patches beneath the thick cover. The earlier/lower deposits now comprise colluvial and alluvial deposits in places, which are succeeded mainly by aeolian (windblown) sands. These older aeolian deposits infilling the broad areas of lower bedrock topography are made up of distinct formations of rapidly accumulated sands, separated by developed soils and pedocretes, such as calcretes, which represent periods of landscape surface stability. Our knowledge of these older aeolianite formations comes from the huge mine pits created by diamond and heavy-mineral mining, but these observations are confined to the lower coastal plain (<~100 m asl.) where marine deposits underlie and are interbedded with the aeolian formations. The major pedocretes present in the mining pits are regional in extent and will occur within the unexposed and unknown aeolian sequences of the higher coastal plain.

The area of aeolian sands labelled as Q-$s_4$ (Figure 1) may be elaborated by extrapolating some of the formations recognised farther south (De Beer (2010) and pers. obs.). The older aeolian formations, such as the **Olifantsrivier** and **Graauw Duinen** formations (Table 1), which are exposed in mine pits and eroding cliffs close to the coast, are rarely exposed on the higher coastal plain inland from ~100 m asl., except as outcrops of their cappings of well-developed pale pedocretes (calcrete, sepiocrete) in places. For the most part these older formations are buried beneath more aeolianites of varying ages and thicknesses which have been transformed by pedogenesis into yellow-brown to red-brown, semi-cemented beds colloquially called "dorbank". Overlying the hard surfaces on the tops of these "**Dorbank formations**" are the poorly-consolidated to loose, surficial sandsheets and dunes of the modern landscape. In the area of interest these are the **Koekenaap** and **Hardevlei** formations (Table 1) (Figures 2 & 3).

The more recent aeolian history is expressed in features of the topography, dune morphologies, sand colours and vegetation patterns. The distribution of the surficial sand formations in the wider area (Figure 3) shows the roles of the river beds and the beaches as sand sources for southerly wind. The white sands of the Swartlintjies dune plume (Figure 3, **Swartlintjies Formation**., Qsw) are the latest large-volume additions to the coastal plain. The plume morphology suggests that the sands were blown by south winds from the beaches now submerged by rising sea levels since the Last Ice Age maximum ~20 ka (ka = thousand years ago) (Figure 4, LGM), when the shoreline was ~120 m below present (Tankard & Rogers, 1978). Similarly, dune plumes blew inland from the coast in the past.

**TABLE 1. NAMAQUALAND COASTAL STRATIGRAPHY**

| **Formation Name** | **Deposit type** | **Age** |
|---|---|---|
| Witzand | Aeolian pale dunes & sandsheets. | Holocene, <~12 ka. |
| **Curlew Strand, Holocene High** | **Marine, 2-3 m Package.** | **Holocene, 7-4 ka.** |
| Swartlintjies & Swartduine | Aeolian dune plumes. | Latest Quat., <20 ka. |
| Hardevlei | Aeolian, semi-active surficial dunes, >100 m asl. | Latest Quat., <25 ka. |
| Koekenaap | Aeolian, surficial red aeolian sands. | later late Quat., 80-30 ka. |
| Unnamed coastal fms. | Aeolianites, limited pedogenesis, weak pedocrete | earlier late Quat., 125-80 ka. |
| **Curlew Strand, MIS 5e, LIG.** | **Marine, 4-6 m Package.** | **earliest late Quat., ~125 ka.** |
| *Fossil Heuweltjiesveld palaeosurface on Olifantsrivier & Dorbank fms.* | | |
| Unnamed "Dorbank" fms. | Aeolian, reddened, semi-lithified. | later mid-Quat., ~400-140 ka. |
| **Curlew Strand, MIS 11** | **Marine, 8-12 m Package.** | **mid Quat., ~400 ka.** |
| Olifantsrivier | Aeolianite, colluvia, pedocrete. | early-mid Quat., ~2-0.4 Ma. |
| Graauw Duinen Member 2 | Aeolianite, colluvia, pedocrete. | latest Plio-early Quat. |
| **Hondeklipbaai** | **Marine, 30 m Package, LPWP.** | **late Pliocene, ~3 Ma.** |
| Graauw Duinen Member 1 | Aeolianite, colluvia, pedocrete. | mid Pliocene. |
| **Avontuur** | **Marine, 50 m Package, EPWP.** | **early Pliocene, ~5 Ma.** |
| Unnamed | Aeolianites, weathered. | later Miocene (14-5 Ma) |
| **Kleinzee** | **Marine, 90 m Package, MMCO.** | **mid Miocene, ~16 Ma.** |
| | | |
| MMCO – Mid Miocene Climatic Optimum. EPWP – Early Pliocene Warm Period. LPWP – Late Pliocene Warm Period. | | |

The variously-reddened, unconsolidated coversands and low, degraded dunes which mantle most of the surface of the coastal plain have been named the **Koekenaap Formation** (Roberts *et al.*, 2006; De Beer, 2010). Preliminary results of Optically-Stimulated-Luminescence (OSL) dating of some reddened coversands (Chase & Thomas, 2006, 2007) produced late Quaternary ages between ~80 ka and ~30 ka (Figure 4) and suggest phases of accumulation which differ between areas. Sand sources include the coast and reworking of older sands, while the older red sands on the higher, inner coastal plain have apparently been sourced from the local rivers.

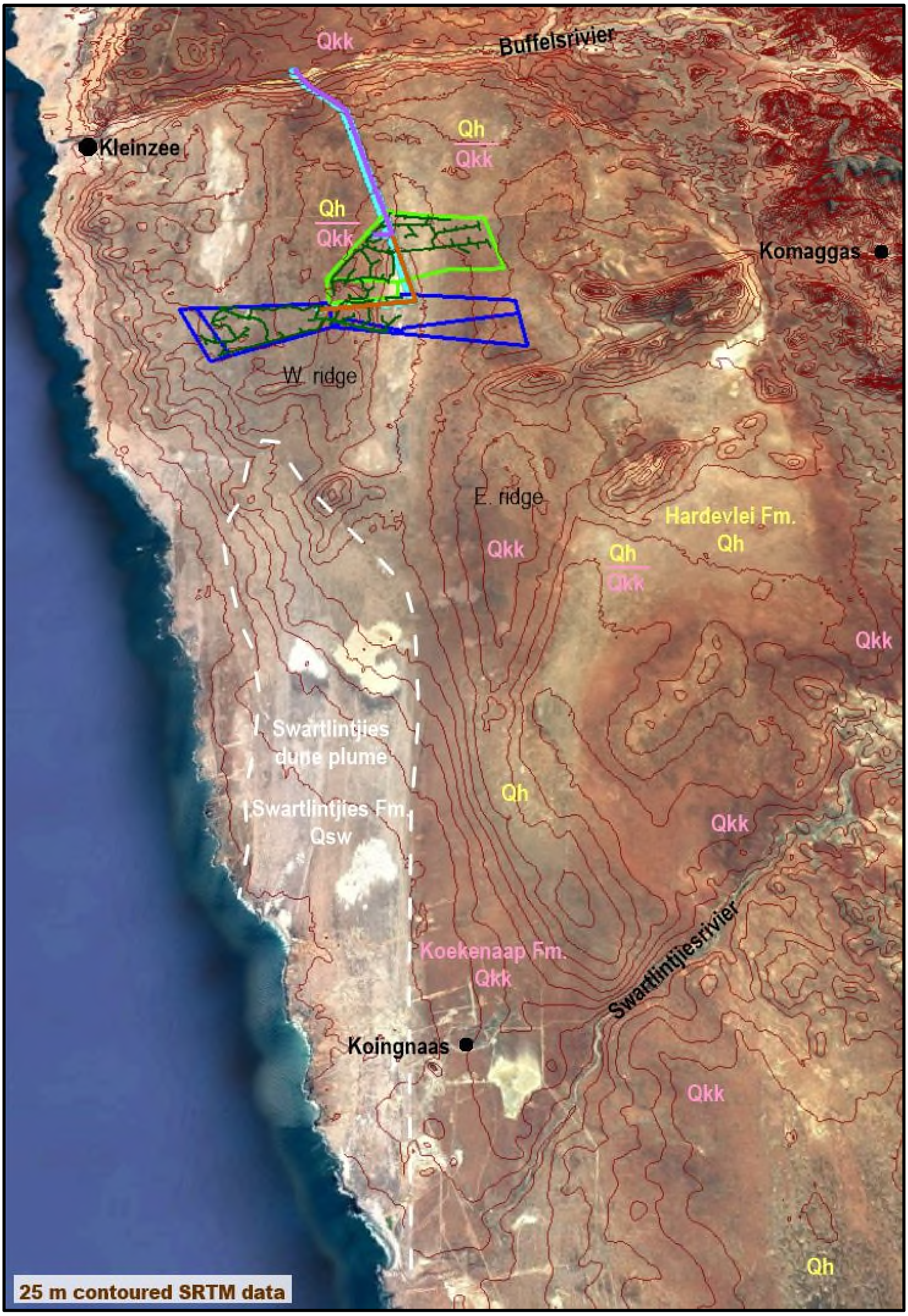



**Figure 3:** Overview of surficial sand formations in the Swartlintjies-Buffels aeolian compartment. Simulated oblique aerial view from Google Earth.

A feature of these older coversands is the development of a patterned vegetation of clumped shrubs which, with ongoing sand movement and ecological feedbacks, evolve into "heuweltjiesveld", a terrain of approximately evenly-spaced low mounds of more fertile sandy soil which are the foci of the biological processes in the coversand ecology. They are inhabited by termites and fossorial animals and burrowed into by aardvarks, meerkats and porcupines. With time, more evolved soils and calcrete lenses form within the maturing heuweltjies, indicative of the relative age of the coversand surface in an area. A "fossil" heuweltjiesveld palaeosurface, buried beneath the current Koekenaap coversands heuweltjiesveld, is seen in southern Namaqualand where the coversands have been removed by mining, exposing the circular calcrete lenses of a former heuweltjiesveld terrain that had formed in the top of the Dorbank Formation there.

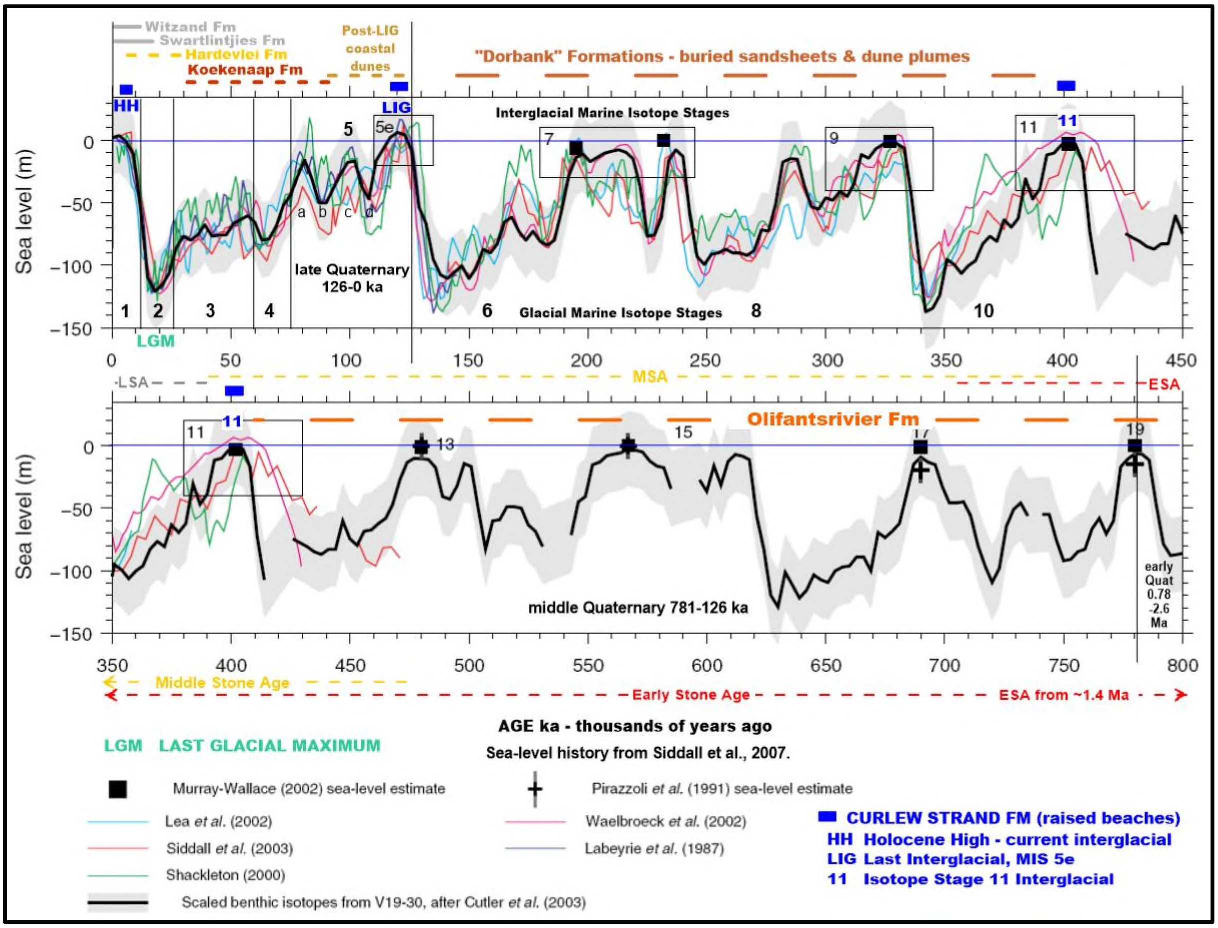



**Figure 4:** Sea-level history and the age ranges of middle and late Quaternary formations of the Namaqualand coastal plain.

At the coast the Koekenaap Fm. is overlain by the pale sands of the Swartlintjies and **Witzand** formations, the latter being smaller, active dune fields linked to local, modern beach sand sources. Farther inland, the latest aeolian activity is manifest in the yellow dunes of the **Hardevlei Formation** (Garies Sheet, De Beer, 2010) which encompasses fields of low, pale-yellow dunes of varied morphology overlying the Koekenaap-type sands or the local Dorbank Fm. Dune types include both parallel, longitudinal sand ridges formed by the northward migration of vegetation-impeded, parabolic, "hairpin" dunes, and transverse, barchanoid (crescentic) dunes. In southern Namaqualand both morphologies are combined to form reticulate dune fields. Dating by the OSL technique indicates ages generally less than ~25 ka (Chase & Thomas, 2006, 2007) (Figure 4).

## 5.2 Local Geological History

Notable large-scale topographic features of the Project Area (Figures 1, 2 & 3) are the red-brown ridge along the western parts of Zonnekwa 326 and Zonnekwa 328 and the eastern part of Rooivlei RE/327, the accompanying low-lying, pale-hued shallow valley forming its eastern flank and the red-brown deposits occupying the rising slope farther to the east (Figure 3). The western ridge is an aeolian depositional feature, the valley is a non-depositional zone and the slope farther east is underlain by the extension of another, older depositional aeolian ridge which stretches all the way from the lower reach of the Swartlintjiesrivier (Figure 3).

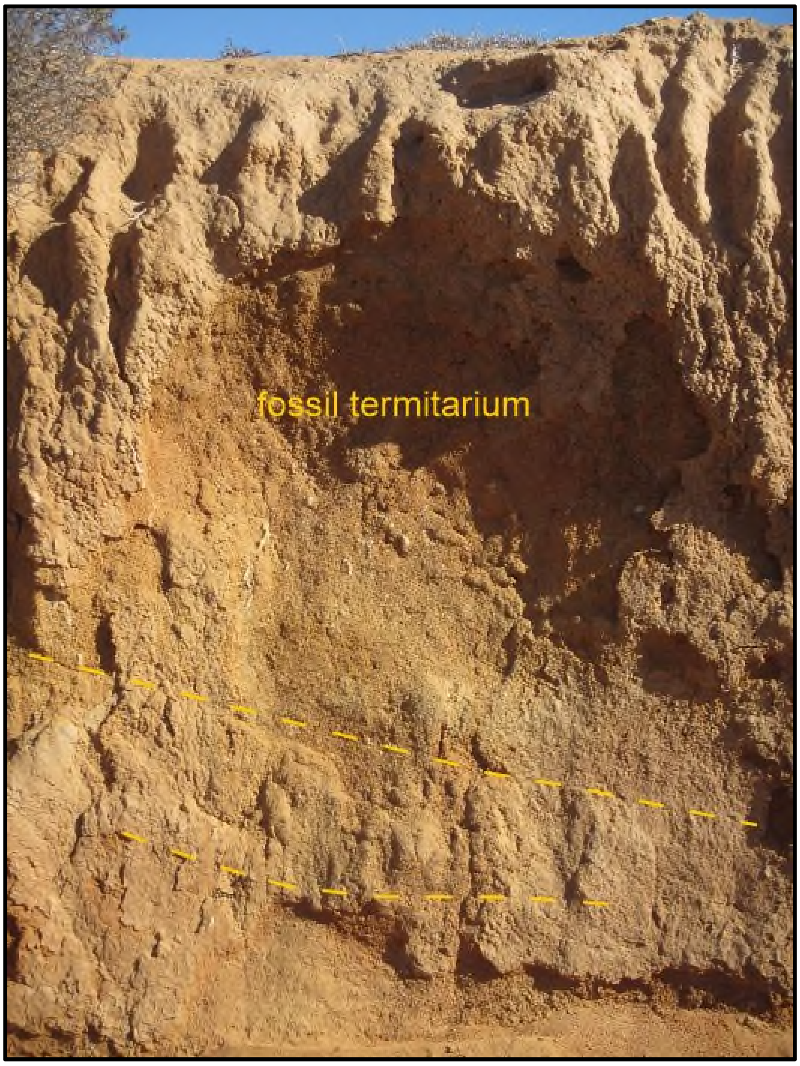



**Figure 5:** The uppermost Dorbank Fm. unit at location 1 in Fig. 2. Dashed lines trace relict dune lower-foreset crossbedding lapping tangentially onto basal wind-ripple laminated interval. Image courtesy of J. Orton.

The central valley is apparently closely underlain by a pale pedocrete beneath which the older formations are expected, equivalent to the **Olifantsrivier** or **Graauw Duinen** formations (Table 1; Figure 2, Qor/Tgr?).

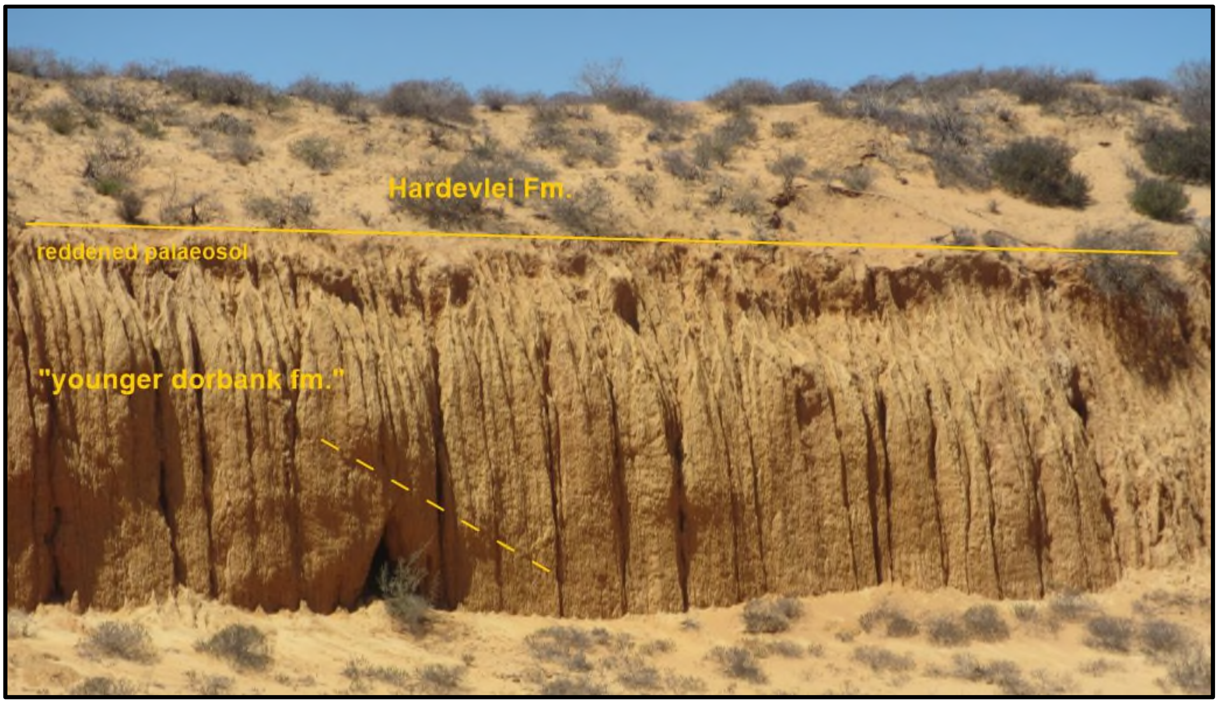



**Figure 6:** The Dorbank Unit at location 2 in Fig. 2. Dashed line indicates relict, steep aeolian foreset crossbedding. Unconsolidated dune sand of the Hardevlei Formation overlies a thin palaeosol. Image courtesy of J. Orton.

A shallow pit in the western ridge flank (Figure 2, location 1) shows the aeolian unit at the top of the compact Dorbank Formation (Figure 5). Another pit in the opposite flank (Figure 2, location 2) shows a similar unit with steep dune crossbedding (Figure 6), considered to be the same formation exposed at location 1. The formation has been subjected to pedogenesis, with the formation of neoformed interstitial clay, but the lack of a developed pedocrete and pedogenic segregations/mottles, and the relatively soft, eroding exposures, indicate that the unit is a relatively young Dorbank formation. The western ridge pre-dates the poorly-consolidated to loose coversands and dunes and is considered to be of later mid-Quaternary age (Figure 4). For instance, at the youngest it is of Marine Isotope Stage (MIS) 6 to MIS 5/6 age. It is on trend with the Swartlintjies dune plume and appears to be an earlier plume that extended considerably farther north (Figure 3). The eastern ridge is assumed to be an older, fossil dune-plume Dorbank formation.

On top of the Dorbank formations are red coversands of the **Koekenaap Formation** and overlying yellow dunes of the **Hardevlei Formation** (Figure 2). The former is exposed in the interdune "streets" which exhibit the clumped vegetation pattern typical of heuweltjiesveld formed on older coversands. The Koekenaap-type coversand is evidently quite thin and may be effectively absent in areas (*e.g*. Figure 6), with the clumped vegetation rooted in the soil on the Dorbank formations.

The Hardevlei Formation dunes are primarily in the form of longitudinal sand ridges (Figure 2), with a spacing of about 100 m and a "fine-grained" vegetation texture. The sand ridges are the trailing arms of parabolic or "hairpin" dunes which typically form when sand transport is partly impeded by vegetation growth. The Hardevlei Fm. dunes formed since ~25 ka, but the older OSL ages occur mainly in southern Namaqualand. The dates from four localities north of the Swartlintjiesrivier indicate that the Hardevlei dunes there have formed during the early to mid-Holocene, from ~12 to ~4 ka, partly contemporaneous with the Swartlintjies Fm. dune plume to the south (Figure 6). It seems the source for the Hardevlei Fm. dunes on the western ridge is sand blowing farther north from the Swartlintjies dune plume, as well as sand reworked from the older coversand and dorbank in erosional areas downwind. On the eastern Zonnekwa slopes the Hardevlei dunes appear to have mainly formed by reworking of the underlying coversands.

The power line corridor traverses across Hardevlei Fm. dune terrain until approaching the Buffelsrivier where there is a dark reddish patch (Figure 3) surrounding a slight hill with outcropping bedrock. The slopes are mantled by old, reddened colluvia that have been lithified to hard pedocrete. The dark red heuweltjiesveld which occurs in the general area is evidently a patch of older Koekenaap Fm. coversands thinly covering the bedrock.

Dark red-brown surficial cover attributable to the Koekenaap Fm. dominates immediately north of the Buffelsrivier (Figure 3). Here 7 metres of red sand accumulated between ~70 to ~20 ka (Site WC03-10, Chase & Thomas, 2007). This illustrates the role of the river as an aeolian compartment boundary, supplying sand for northward transport and impeding sand encroachment from the south by its periodic removal.

## 6 ANTICIPATED IMPACTS

The fossil bones that have been found hitherto in the aeolianites of Namaqualand attest to the fossil potential that will be delivered by the continuation of systematic searches for these sparse remains. Fossil material most commonly seen is the ambient fossil content of dune sands: land snails, tortoise shells and mole bones. Other small bones occur very sparsely such as bird and small mammal bones. The fossil content is more abundant in association with palaeosurfaces and their soils (palaeosols), formed during periods of dune stabilisation and which define aeolian packages and larger formations. Importantly, the bones of larger animals (*e.g.* antelopes) are more persistently present along palaeosurfaces which separate the major aeolianite units. Large caches of bones have been found in aardvark burrows that were subsequently occupied by hyaenas.

Although fossil bones are very sparse in aeolian Dorbank formations and overlying coversands and dunes, they are of high scientific value and important for palaeoclimatic, palaeobiological and biostratigraphic studies. The fossil material in these deposits is a sample of the middle and late Quaternary fauna of the Namaqualand coast. For example, fossil bones in aeolianite near the Swartlintjiesrivier were associated with Early Stone Age artefacts and include large species (elephant, sivathere, zebra). *Sivatherium maurusium* was a large, heavily-built short-necked giraffid common in Africa between ~5.0 to ~0.4 Ma. In addition small species were collected (hare, squirrel, moles, snakes). The estimated age is mid-Quaternary and the large mammals indicate that the coast was better watered than the present-day (Pickford & Senut, 1997).

A late Quaternary fauna was obtained from calcareous interdune deposits exposed between the dunes of the Swartlintjies Formation. The presence of frogs indicates a damp environment. Larger species include ostrich, zebra and steenbok and oddly, giraffe, a tree browser. A variety of small rodent taxa occurred. Other than the giraffe, the fauna is essentially modern. The giraffe suggests that woodland still occurred in Namaqualand as recently as the late Quaternary, probably related to riverine settings and wetter conditions associated with ice age climate (Pickford & Senut, 1997), or wet spells during the deglaciation.

The dimensions of the wind turbine foundation slabs are 20 X 20 X 3 m. There will be a considerable number of them (~99) distributed over and "sampling" a wide area. Therefore, in spite of the overall low fossil potential, there is a distinct possibility that fossil bones may be exposed in some of the excavations. The top of the Dorbank formations will be intersected, on which fossil bones and Stone Age archaeological material occur, as is quite commonly observed where the unconsolidated sands have been blown away, exposing the surface. This material will include objects that were in the coversands, as well as bones and artefacts originally deposited on the Dorbank Unit surface. Where the Dorbank Unit is thinner along the edges of the depositional ridges, the underlying, potentially-fossiliferous palaeosurface and pedocrete on top of an older formation will be intersected. The valley between the depositional ridges may have hosted pans or waterholes during wetter periods in the past, with considerably greater fossil potential.

The excavations for cabling and other infrastructure are shallow and mainly affect the coversands, but the cabling trenches will traverse considerable lengths across the Project Area and intersect the top of the Dorbank Unit in places. The footings of the transmission line pylons that connect to the grid are likely to be minor in scale and have a low likelihood of fossil finds, although not altogether absent.

# 7 IMPACT ASSESSMENT – CONSTRUCTION PHASE

## 7.1 Nature of the Impact of Bulk Earth Works 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 with respect to palaeoecological and biostratigraphic (dating) information. Such fossils are non-renewable resources. Provided that no subsurface disturbance occurs, the fossils remain sequestered there.

Overall the palaeontological sensitivity of coastal deposits is HIGH (Almond & Pether, 2009) due to previous fossil finds of high scientific importance. 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, provided that efforts are made to watch out for and rescue the fossils. 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. The very scarcity of fossils makes for the added importance of looking out for them.

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.

### 7.2 Extents

The physical extent of impacts on potential palaeontological resources relates directly to the extents of subsurface disturbance involved in the installation of infrastructure during the Construction Phase, *i.e.* LOCAL.

However, unlike an impact that has a defined spatial extent (*e.g.* loss of a portion of a habitat), the cultural, heritage and scientific impacts are of regional to national extent, as is implicit in the National Heritage Resources Act No. 25 (1999) and, if scientifically important specimens or assemblages are uncovered, are of international interest. This is evident in the amount of foreign-funded palaeontological research that takes place in South Africa by scientists of other nationalities. Loss of opportunities that may arise from a significant fossil occurrence (tourism, employment) filters down to regional/local levels.

### 7.3 Duration

The initial duration of the impact is shorter term (<5 years) and primarily related to the Construction Phase when excavations for infrastructure are made. This is the "time window" for mitigation.

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. The duration of impact is therefore PERMANENT with or without mitigation.

### 7.4 Intensity

The intensity or magnitude of impact relates to the palaeontological sensitivities of the formations (Appendix 1). Due to the overall sparse distribution of fossil bones in the affected formations the sensitivity is considered to be LOW.

### 7.5 Probability

In consideration of the scale of subsurface disturbance it is PROBABLE that fossil bones will be unearthed.

### 7.6 Impact Significance Rating

This impact assessment, according to the scheme in Appendix 2, does not differentiate between formations as the palaeontological sensitivities of the affected formations with respect to the occurrence of fossil bones are all low.

| ***Nature: Direct destruction of or damage to fossil bones or resources through excavation of foundations and trenches in all aeolian formations.*** | | |
|---|---|---|
| | **Without mitigation** | **With mitigation** |
| ***Extent*** | Study area (2) | Study area (2). If important fossil find becomes regional-international (3-5) |
| ***Duration*** | Permanent (5) | Permanent (5) |
| ***Magnitude*** | Low (4) | Low (4) |
| ***Probability*** | Probable (3) | Probable (3) |
| ***Significance*** | **33 (Medium)** | **33 (Medium)** |
| ***Status (positive or negative)*** | Negative | Positive |
| ***Reversibility*** | Irreversible | Irreversible |
| ***Irreplaceable loss of resources?*** | Yes | Partly |
| ***Can impacts be mitigated?*** | Yes, but only partial mitigation is possible. Valuable fossils may be lost in spite of management actions to mitigate such loss. | |
| ***Mitigation:***<br>» Monitoring of all construction-phase excavations by project staff and ECO.<br>» Inspection, sampling and recording of selected exposures in the event of fossil finds.<br>» Fossil finds and the compiled contextual report deposited in a curatorial scientific institution. | | |
| ***Residual Impacts:*** It will never be possible to spot and rescue all fossils which means that there will always be some loss and therefore residual impact. This would be of unknown significance because of the sparse distribution of fossils in the broader landscape. Positive impacts would continue to be felt with successful mitigation because of the scientific implications of the resulting research opportunities | | |

## 8 RECOMMENDATIONS

The Medium/moderate level of significance indicates that the palaeontological impact does not greatly influence the decision to develop the area, but appropriate mitigation measures are required. Therefore, the development of the wind farms within the project sites is considered to be acceptable from a palaeontological perspective and can be authorised, subject to the implementation of the recommended mitigation measures.

If palaeontological mitigation is applied to these projects as recommended, it is possible that these developments will to some extent alleviate the negative cumulative impact on paleontological resources in the region.

The history of these vast tracts of sands, gravels and pedocretes of the Northern Cape is very poorly known, with very few fossils to rely on. Therefore, though of low probability, any find will be of considerable importance and could add to the scientific knowledge of the area in a positive manner.

### 8.1 Monitoring

In view of the low fossil potential, monitoring of bulk earth works by a specialist is not justified. Notwithstanding, the sporadic fossil occurrences are then particularly important and efforts made to spot them are often rewarded. Buried archaeological material may also be encountered. It is recommended that a requirement to be alert for possible fossils and buried archaeological material be included in the EMPr for the Construction Phase of the proposed Namas and Zonnequa Wind Farms and power lines, with a Fossil Finds Procedure in place.

The field supervisor/foreman and workers involved in digging excavations must be informed of the need to look out for fossils and buried potential archaeological material. Workers seeing potential objects are to cease work at that spot and to report to the field supervisor who, in turn, will report to the Environmental Control Officer (ECO). The ECO will inform the developer and contact the palaeontologist contracted to be on standby in the case of fossil finds. The latter will liaise with SAHRA on the nature of the find and consequent actions (permitting and collection of find).

The Fossil Finds Procedure included as Appendix 3 provides guidelines to be followed in the event of fossil finds. Only a professional palaeontologist may excavate uncovered fossils with a valid mitigation permit from SAHRA.

## 8.2 Basic Measures for the Construction Phase EMPr

The following measures apply to all earthworks affecting all formations discussed above.

| | |
|---|---|
| **OBJECTIVE: To see and rescue fossil material that may be exposed in the excavations made for installation of the wind farms.** | |
| **Project components** | Turbine foundation excavations, trenches for cabling & infrastructure, powerline footings, 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. | The Developer, the ECO and contractors. | Pre-construction. |
| Inform staff of the Fossil Finds Procedures to be followed in the event of fossil occurrences. | ECO/Specialist. | Pre-construction. |
| Monitor for the presence of fossils. | Contracted personnel and ECO. | Construction. |
| Liaise with palaeontologist on the nature of potential finds and appropriate actions. | ECO and Specialist, SAHRA. | Construction. |
| Obtain a permit from SAHRA for the fossil finds collection should resources be discovered. | Developer and Specialist. | Construction |
| Excavate main finds, inspect pits and record and sample excavations. | Specialist. | Construction. |

| | |
|---|---|
| **Performance Indicator** | • Reporting of and liaison about possible fossil finds.<br>• Fossils noticed and rescued.<br>• Scientific record of fossil contexts and temporary exposures in earthworks. |
| **Monitoring** | • Ensure staff are aware of fossils and the procedure to follow when found.<br>• ECO to conduct inspections of open excavations whenever on site. |

## 9 REFERENCES


Almond, J.E. & Pether, J. 2009. Palaeontological Heritage of the Northern Cape. SAHRA Palaeotechnical Report, Natura Viva cc., Cape Town.

Chase, B.M. & Thomas, D.S.G. 2006. Late Quaternary dune accumulation along the western margin of South Africa: distinguishing forcing mechanisms through the analysis of migratory dune forms. Earth and Planetary Science Letters 251: 318–333.

Chase, B.M. & Thomas, D.S.G. 2007. Multiphase late Quaternary aeolian sediment accumulation in western South Africa: timing and relationship to palaeoclimatic changes inferred from the marine record. Quaternary International 166: 29–41.

De Beer, C.H. 2010. The geology of the Garies area. Explanation: 1:250000 Sheet 3017 Garies. Council for Geoscience South Africa. 100 pp.

Marais, J.A.H., Agenbacht, A.L.D., Prinsloo, M. & Basson, W.A. 2001. The geology of the Springbok area. Explanation of 1:250 000 Sheet 2917 (Springbok), Council for Geoscience, 103 pp.

Pickford, M. and Senut, B. 1997. Cainozoic mammals from coastal Namaqualand, South Africa. Palaeontologia Africana., 34, 199-217.

Roberts, D.L., Botha, G.A., Maud, R.R. & Pether, J. 2006. Coastal Cenozoic Deposits (Chapter 30). In: Johnson, M. R., Anhaeusser, C. R. and Thomas, R. J. (eds.), The Geology of South Africa. Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria: 605-628.

Siddall, M., Chappell, J. & Potter, E.-K. 2007. Eustatic sea level during past interglacials. The Climate of Past Interglacials: Developments in Quaternary Science 7: 75-92.

Tankard, A.J. & Rogers, J. 1978. Late Cenozoic palaeoenvironments on the west coast of southern Africa. Journal of Biogeography, 5, 319-337.

## 10 APPENDIX 1 - PALAEONTOLOGICAL SENSITIVITY RATING

Palaeontological Sensitivity refers to the likelihood of finding significant fossils within a geologic unit.

**VERY HIGH:** Formations/sites known or likely to include vertebrate fossils pertinent to human ancestry and palaeoenvironments and which are of international significance.

**HIGH:** Assigned to geological formations known to contain palaeontological resources that include rare, well-preserved fossil materials important to on-going palaeoclimatic, palaeobiological and/or evolutionary studies. Fossils of land-dwelling vertebrates are typically considered significant. Such formations have the potential to produce, or have produced, vertebrate remains that are the particular research focus of palaeontologists and can represent important educational resources as well.

**MODERATE:** Formations known to contain palaeontological localities and that have yielded fossils that are common elsewhere, and/or that are stratigraphically long-ranging, would be assigned a moderate rating. This evaluation can also be applied to strata that have an unproven, but strong potential to yield fossil remains based on its stratigraphy and/or geomorphologic setting.

**LOW:** Formations that are relatively recent or that represent a high-energy subaerial depositional environment where fossils are unlikely to be preserved, or are judged unlikely to produce unique fossil remains. A low abundance of invertebrate fossil remains can occur, but the palaeontological sensitivity would remain low due to their being relatively common and their lack of potential to serve as significant scientific resources. However, when fossils are found in these formations, they are often very significant additions to our geologic understanding of the area. Other examples include decalcified marine deposits that preserve casts of shells and marine trace fossils, and fossil soils with terrestrial trace fossils and plant remains (burrows and root fossils)

**MARGINAL:** Formations that are composed either of volcaniclastic or metasedimentary rocks, but that nevertheless have a limited probability for producing fossils from certain contexts at localized outcrops. Volcaniclastic rock can contain organisms that were fossilized by being covered by ash, dust, mud, or other debris from volcanoes. Sedimentary rocks that have been metamorphosed by the heat and pressure of deep burial are called metasedimentary. If the meta sedimentary rocks had fossils within them, they may have survived the metamorphism and still be identifiable. However, since the probability of this occurring is limited, these formations are considered marginally sensitive.

**NO POTENTIAL:** Assigned to geologic formations that are composed entirely of volcanic or plutonic igneous rock, such as basalt or granite, and therefore do not have any potential for producing fossil remains. These formations have no palaeontological resource potential.

*Adapted from Society of Vertebrate Paleontology. 1995. Assessment and Mitigation of Adverse Impacts to Nonrenewable Paleontologic Resources - Standard Guidelines. News Bulletin, Vol. 163, p. 22-27.*

## 11 APPENDIX 2 - METHODOLOGY FOR IMPACT ASSESSMENT

| | | | |
|---|---|---|---|
| EFFECT | **Extents/Spatial Scale** | | **E** |
| | Localised | At localised scale and a few hectares in extent . | 1 |
| | Study area | The proposed site and its immediate environs. | 2 |
| | Regional | District and Provincial level. | 3 |
| | National | Country. | 4 |
| | International | Internationally. | 5 |
| | **Duration/Temporal Scale** | | **D** |
| | Very short | Less than 1 year. | 1 |
| | Short term | Between 2 to 5 years. | 2 |
| | Medium term | Between 5 and 15 years. | 3 |
| | Long term | Exceeding 15 years and from a human perspective almost permanent. | 4 |
| | Permanent | Resulting in a permanent and lasting change. | 5 |
| | **Magnitude/Intensity (Palaeontological Sensitivity)** | | **M** |
| | No potential | Formations entirely lacking fossils such as igneous rocks. | 0 |
| | Marginal | Limited probability for producing fossils from certain contexts at localized outcrops. | 2 |
| | Low | Depositional environment where fossils are unlikely to be preserved, or are judged unlikely to produce unique fossil remains. | 4 |
| | Medium | Strong potential to yield fossil remains based on stratigraphy and/or geomorphologic setting. | 6 |
| | High | Formations known to contain palaeontological resources that include rare, well-preserved fossil materials. | 8 |
| | Very high | Formations/sites known or likely to include vertebrate fossils pertinent to human ancestry and palaeoenvironments and which are of international significance. | 10 |
| PROBABILITY | **Probability/Likelihood** | | **P** |
| | Very improbable | Probably will not happen. | 1 |
| | Improbable | Some possibility, but low likelihood. | 2 |
| | Probable | Distinct possibility of these impacts occurring. | 3 |
| | Highly probable | The impact is most likely to occur. | 4 |
| | Definite | The impact will definitely occur regardless of prevention measures. | 5 |

| **SIGNIFICANCE = (E+D+M)P** | | |
|---|---|---|
| < 30 | LOW | The impact would not have a direct influence on the decision to develop in the area |
| 30-60 | MEDIUM | The impact could influence the decision to develop in the area unless it is effectively mitigated |
| >60 | HIGH | The impact must have an influence on the decision process to develop in the area |

## 12 APPENDIX 3 - FOSSIL FIND PROCEDURE

### Monitoring

A constant monitoring presence over the period during which excavations for developments are made, by either an archaeologist or palaeontologist, is generally not practical.

The field supervisor/foreman and workers involved in digging excavations must be encouraged and informed of the need to watch for potential fossil and buried 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.

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/Site Agent.

### Response by personnel in the event of fossil finds

In the process of digging the excavations fossils may be spotted in the hole sides or bottom, or as they appear in excavated material on the spoil heap.

» Stop work at fossil find. The site foreman and ECO must be informed.
» Protect the find site from further disturbance and safeguard all fossil material in danger of being lost such as in the excavator bucket and scattered in the spoil heap.
» The ECO or site agent must immediately inform the South African Heritage Resources Agency (SAHRA) and/or the contracted standby palaeontologist of the find and provide via email the information about the find, as detailed below.
  * Date
  * Position of the excavation (GPS) and depth.
  * A description of the nature of the find.
  * Digital images of the excavation showing vertical sections (sides) and the position of the find showing its depth/location in the excavation.
  * A reference scale must be included in the images (tape measure, ranging rod, or object of recorded dimensions).
  * Close-up, detailed images of the find (with scale included).

The South African Heritage Resources Agency (SAHRA) and/or the contracted standby palaeontologist will assess the information and a suitable response will be established which will be reported to the developer and the ECO, such as whether rescue excavation or rescue collection by a palaeontologist is necessary or not.

The response time/scheduling of the rescue fieldwork is to be decided in consultation with developer/owner and the ECO. It will probably be feasible to "leapfrog" the find and proceed to the next excavation, or continue a trench excavation farther along, so that the work schedule and machine time is minimally disrupted. The strategy is to rescue the material as quickly as possible.

**Application for a Permit to Collect Fossils**

A permit from SAHRA is required to excavate fossils. The applicant should be the qualified specialist responsible for assessment, collection and reporting (palaeontologist). Should fossils be found that require rapid collecting, application for a palaeontological permit must be made to SAHRA immediately. All fossils must be deposited at a SAHRA-approved institution.

In addition to the information and images of the find, the application requires details of the registered owners of the sites, their permission and a site-plan map.

## APPENDIX 3: MAPPING

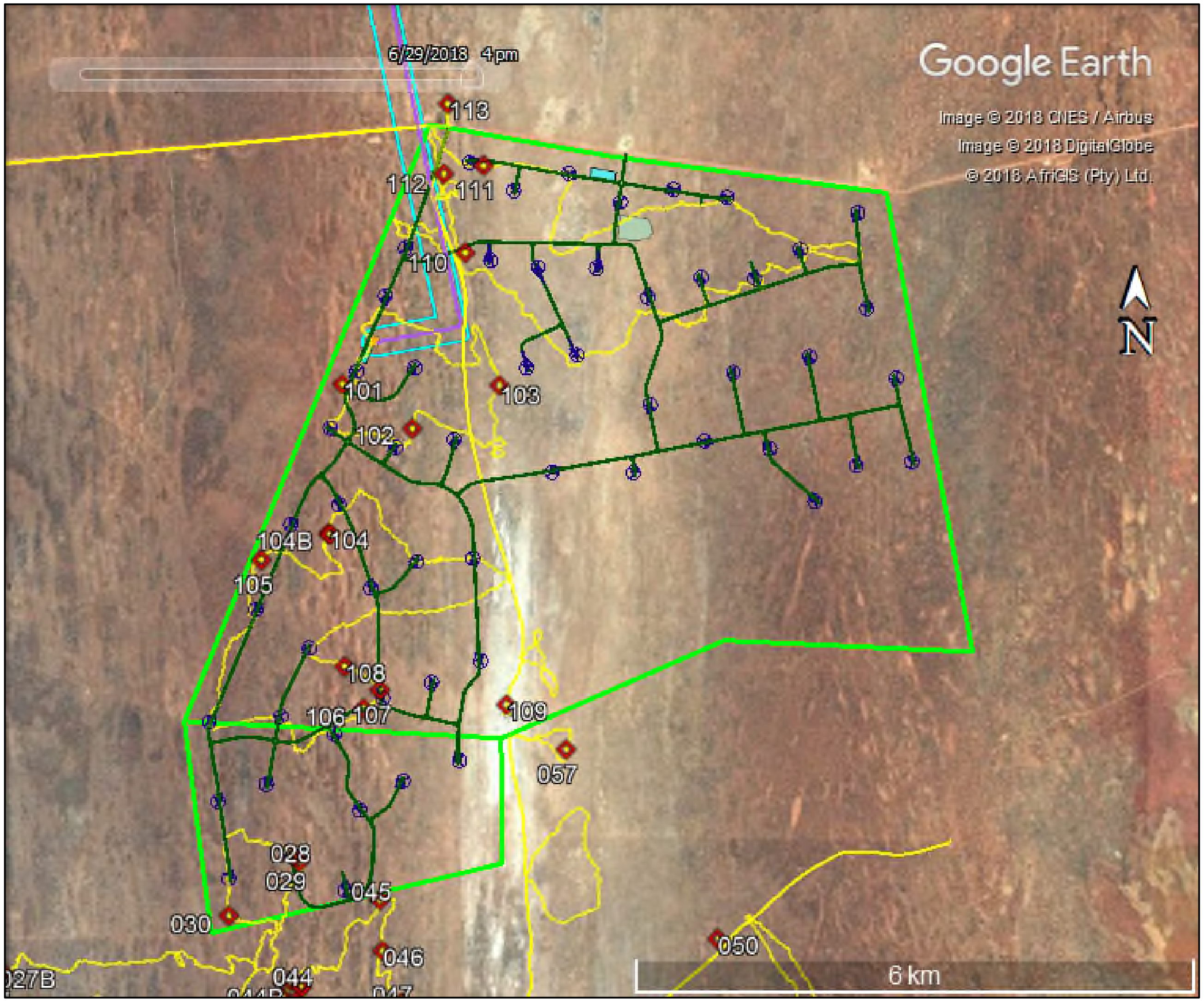



***Figure A3.1:*** *Map of the wind farm study area (green polygons) and southern part of the power line corridor (turquoise) showing the road (dark green) and turbine (dark blue) layouts, the survey tracks (yellow lines) and archaeological finds (numbered red symbols). Other infrastructure is indicated by small coloured polygons.*

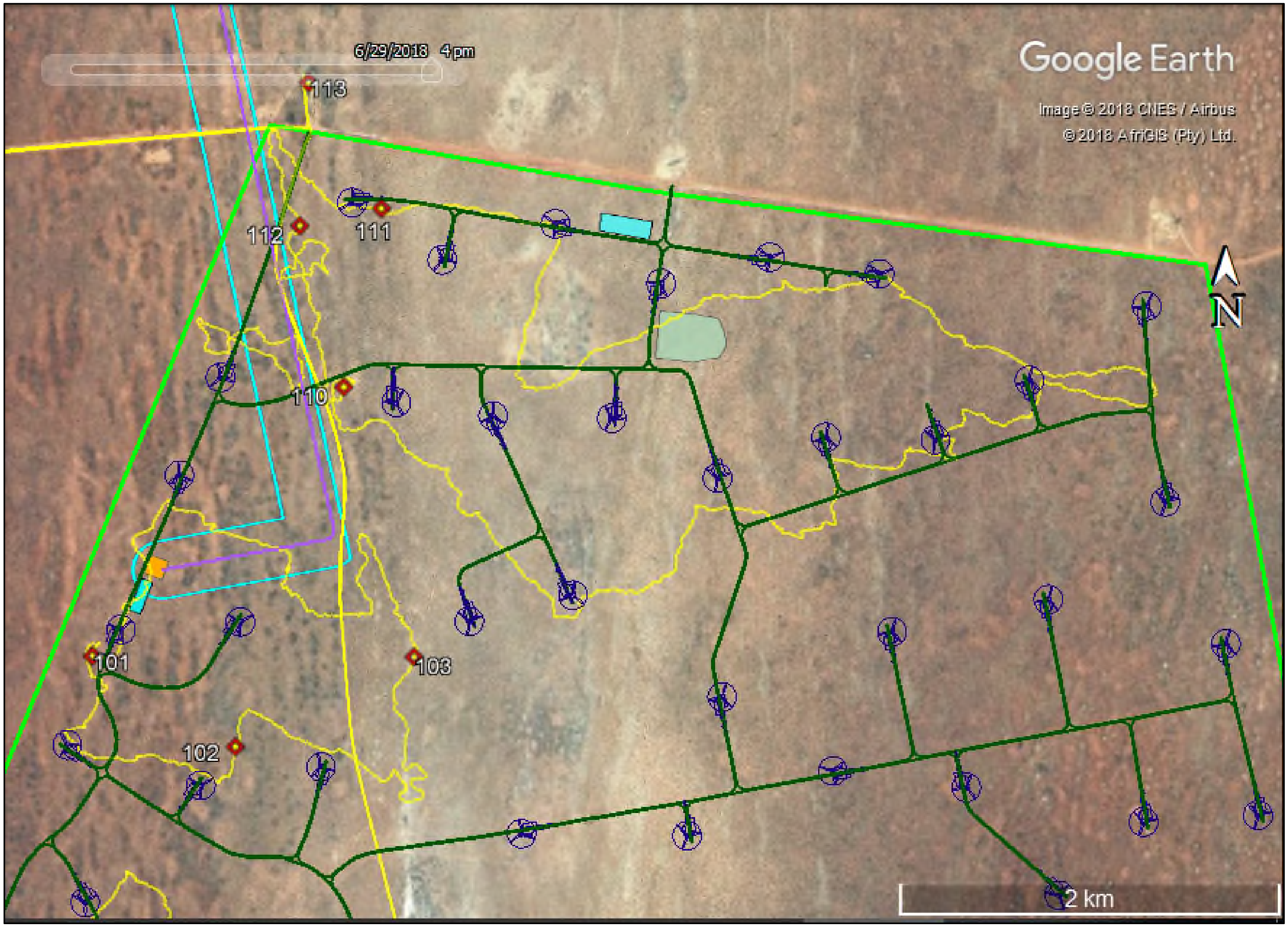



***Figure A3.2:*** *Close up of the northern part of the wind farm study area (see caption for Figure A3.1).*

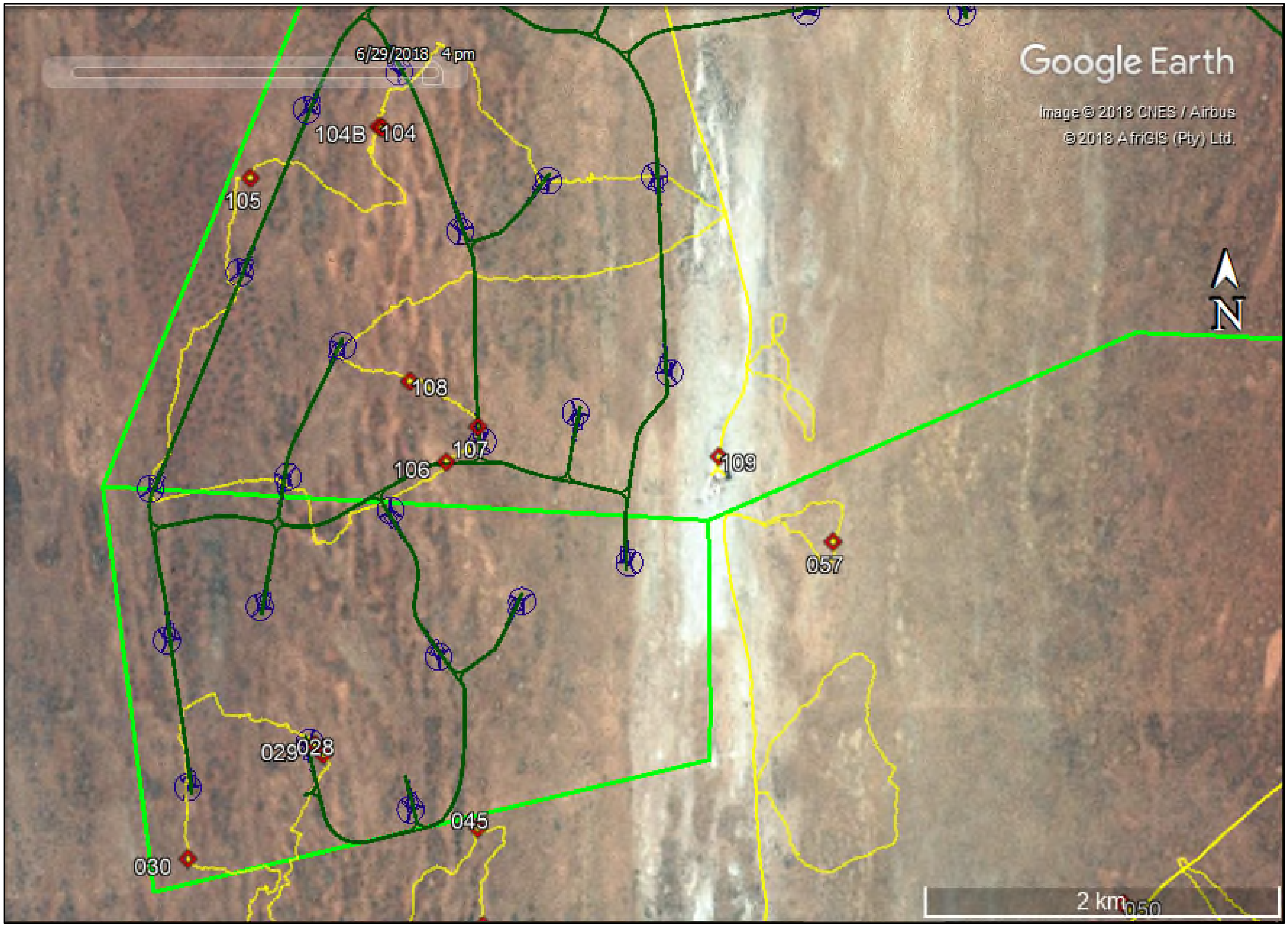



***Figure A3.3:*** *Close up of the northern part of the wind farm study area (see caption for Figure A3.1).*

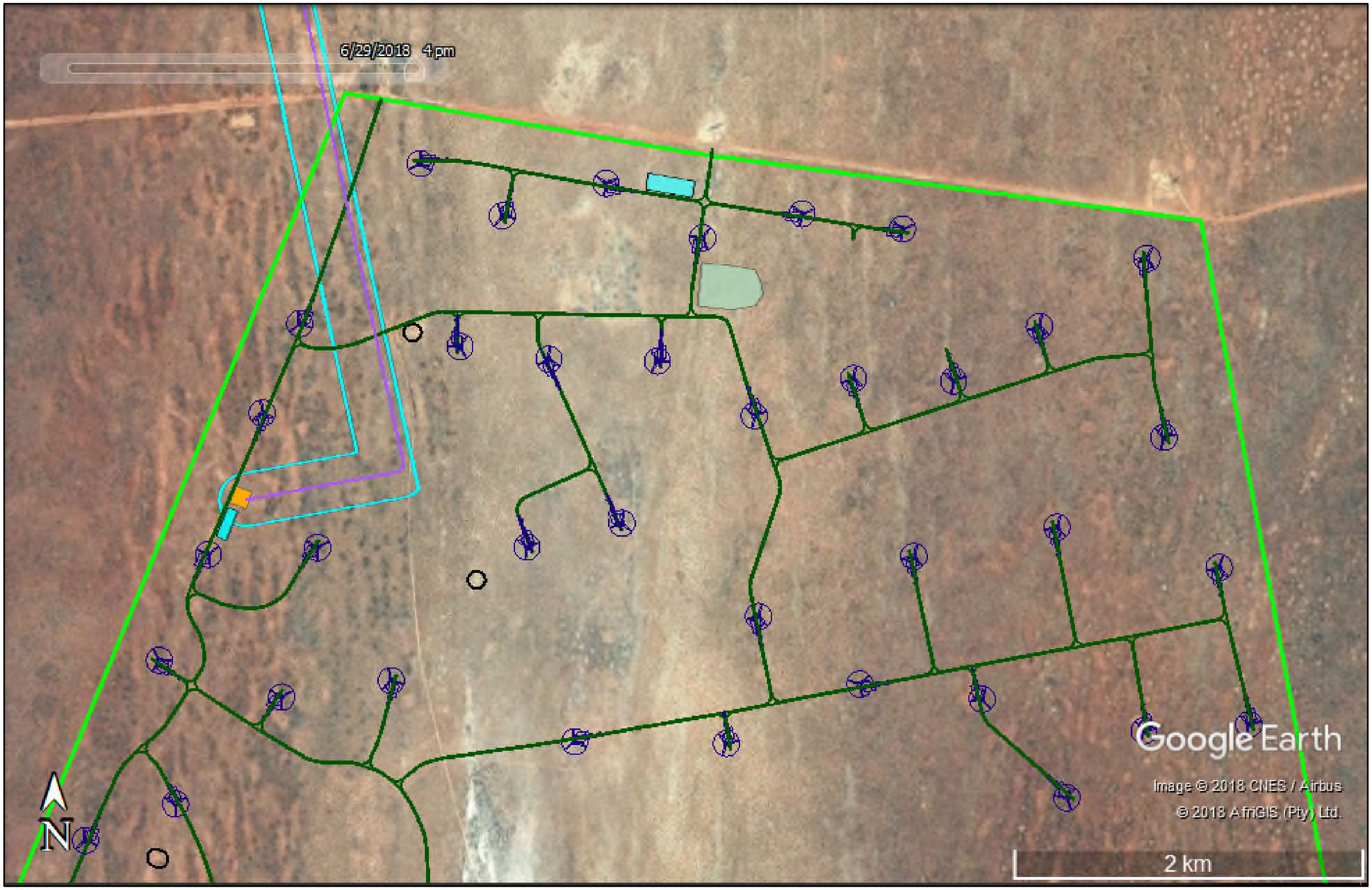



***Figure A3.4:*** *Map showing 50 m buffers from the centre point of all significant archaeological sites (black circles) relative to the proposed development (northern section).*

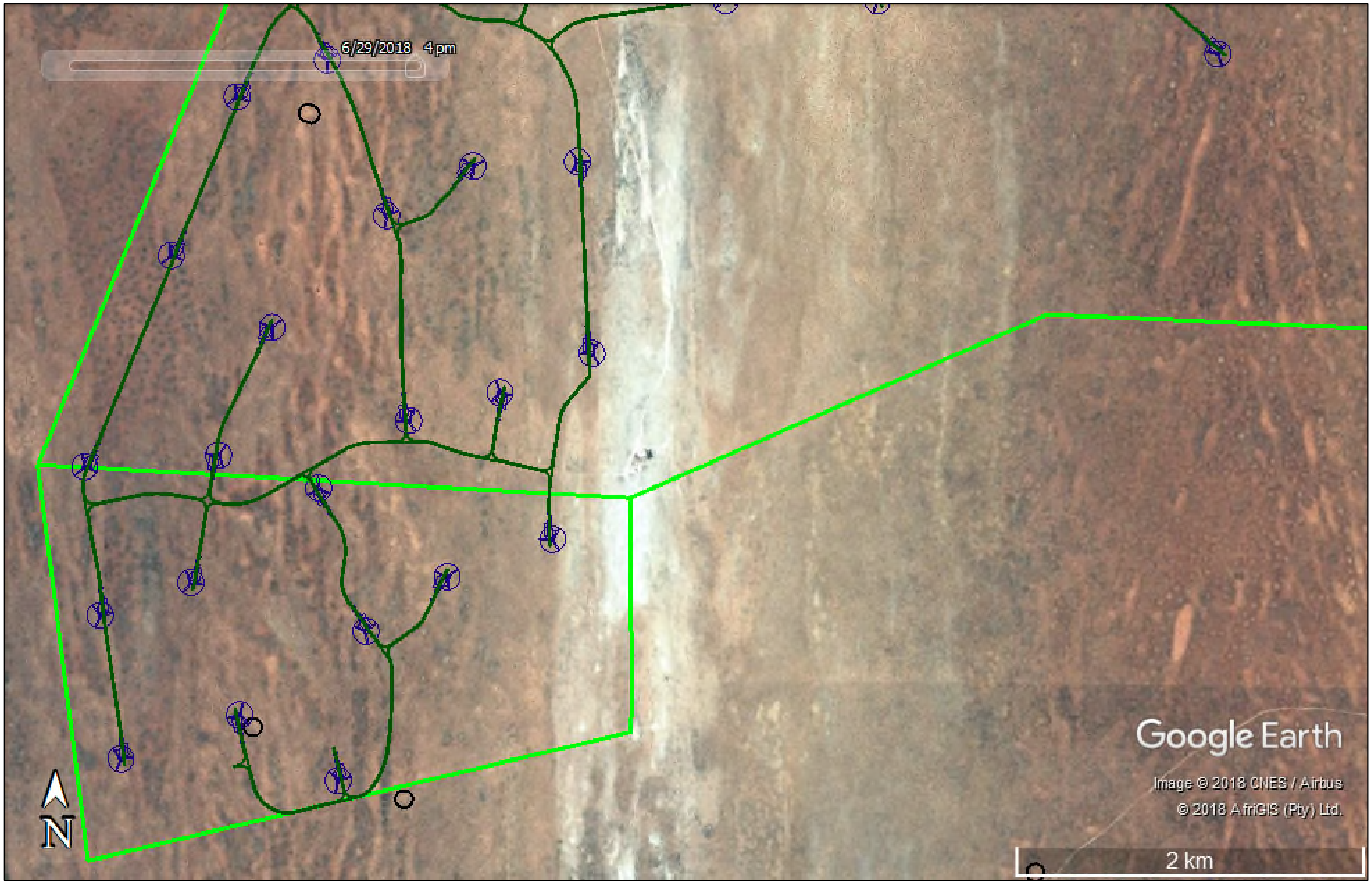



***Figure A3.5:*** *Map showing 50 m buffers from the centre point of all significant archaeological sites (black circles) relative to the proposed development (southern section).*