DESKTOP PALAEONTOLOGICAL HERITAGE IMPACT ASSESSEMENT REPORT ON THE SITE OF THE PROPOSED GUNSTFONTEIN WIND ENERGY GENERATION FACILITY TO BE LOCATED ON VARIOUS FARMS NEAR SUTHERLAND, NORTHERN CAPE PROVINCE

Prepared for:

Savannah Environmental (Pty) Ltd

On Behalf of:

Gunstfontein Wind Farm (Pty) Ltd

Prepared By:

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EXECUTIVE SUMMARY

Gunstfontein Wind Farm (Pty) Ltd has identified a site for the establishment of their Gunstfontein Wind Energy Facility. The site identified for the proposed development is located approximately 20 km south of Sutherland in the Karoo Hoogland Local Municipality, Sutherland Magisterial District in the Northern Cape Province (Figure 1).

The project site occupies an area of approximately 12 000 Ha and is located wholly within Portion 1 of the farm Gunstfontein 131, the Remainder of the farm Gunstfontein 131, Boschmans Hoek 177 and Remainder of the farm Wolven Hoek 182. Anticipated, herein, is that given the number of wind turbines planned (as well as the associated infrastructure) the area that will eventually be impacted will not affect the entire extent of the area reported upon herein. Thus, the location of each infrastructure element can be finalised taking environmental and any other identified constraints into consideration.

Gunstfontein Wind Farm (Pty) Ltd has appointed Savannah Environmental (Pty) Ltd, as independent consultants, to undertake a Scoping and Environmental Impact Assessment Study to identify and assess all potential environmental impacts associated with the proposed project for the area as identified, and propose appropriate mitigation measures in an Environmental Management Programme ("EMPr"). Savannah Environmental (Pty) Ltd has appointed BM Geological Services to provide a Desktop Palaeontological Heritage Impact Assessment Report in respect of the proposed project that will form part of the final Heritage Impact assessment Report.

Rocks of the Abrahamskraal Formation underlie the project area. It is known that elsewhere in the Main Karoo Basin, this rock unit is fossiliferous and, as such, it can be anticipated that the unit contains fossils within the project area.

The potential for a negative impact on the fossil heritage of the area can be quantified in the following manner. The probability of a negative impact on the palaeontological heritage of the Abrahamskraal Formation is low due to the general scarcity and sporadic nature of fossils within the geological record. However, the vertebrate faunas contained within the formations are potentially significant in, amongst other reasons, documenting the evolutionary transition from reptiles to mammals. The plant macrofossil assemblages contained within the unit potentially provide a window into the botanical record of the Late Permian which is otherwise rare in southern Africa. Thus, any negative impact upon the fossil assemblages contained within these geological units is characterised as potentially highly significant. However, the probability of any negative impact being caused upon the fossil assemblages occurring within the project area is assessed as low. It is pertinent to note that the area of any potential negative impact caused by the project is characterised as local in extent. Similarly, the zone of permanent disruption is vertically restricted to the maximum depth of any excavations associated with the proposed constructions.

The project has been assessed as being socially beneficial, herein, as it would provide renewable energy to an increasingly stressed South African power grid. The possibility of any negative impact on the palaeontological heritage of the project area could be minimised by the conduct of a thorough site investigation (as part of a Full Palaeontological Impact assessment Study) by a palaeontologist prior to commencement of the project. This site investigation would make it possible that scientifically and/or culturally significant fossils may be discovered that would be otherwise damaged, destroyed or inadvertently moved. Similarly, a regular examination should be made of all excavations as they are being performed. Should any fossil materials be identified during the construction phase, the excavations should be halted and SAHRA informed of the discovery. A potential positive outcome of these mitigation protocols could be that fossil materials become available for scientific study that would otherwise have been hidden within or beneath the regolith. Should such new palaeontological material be located as a result of this site investigation this could prove to have a positive effect on the understanding of the fossil record of South Africa and positively affect the palaeontological heritage of the country.

In summary, this desktop study has not identified any palaeontological reason to prejudice the progression of this project, subject to the stipulated mitigation programs being put in place.

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2 TERMS OF REFERENCE AND SCOPE OF THE STUDY

The terms of reference for this study were as follows:-

- Conduct a desktop assessment of the potential impact of the proposed project on the palaeontological heritage of the project area.
- Describe the possible impact of the proposed development on the palaeontological heritage of the site, according to a standard set of conventions.
- Quantify the possible impact of the proposed development on the palaeontological heritage of the site, according to a standard set of conventions.
- Provide an overview of the applicable legislative framework.
- Make recommendations concerning future work programs as, and if, necessary.

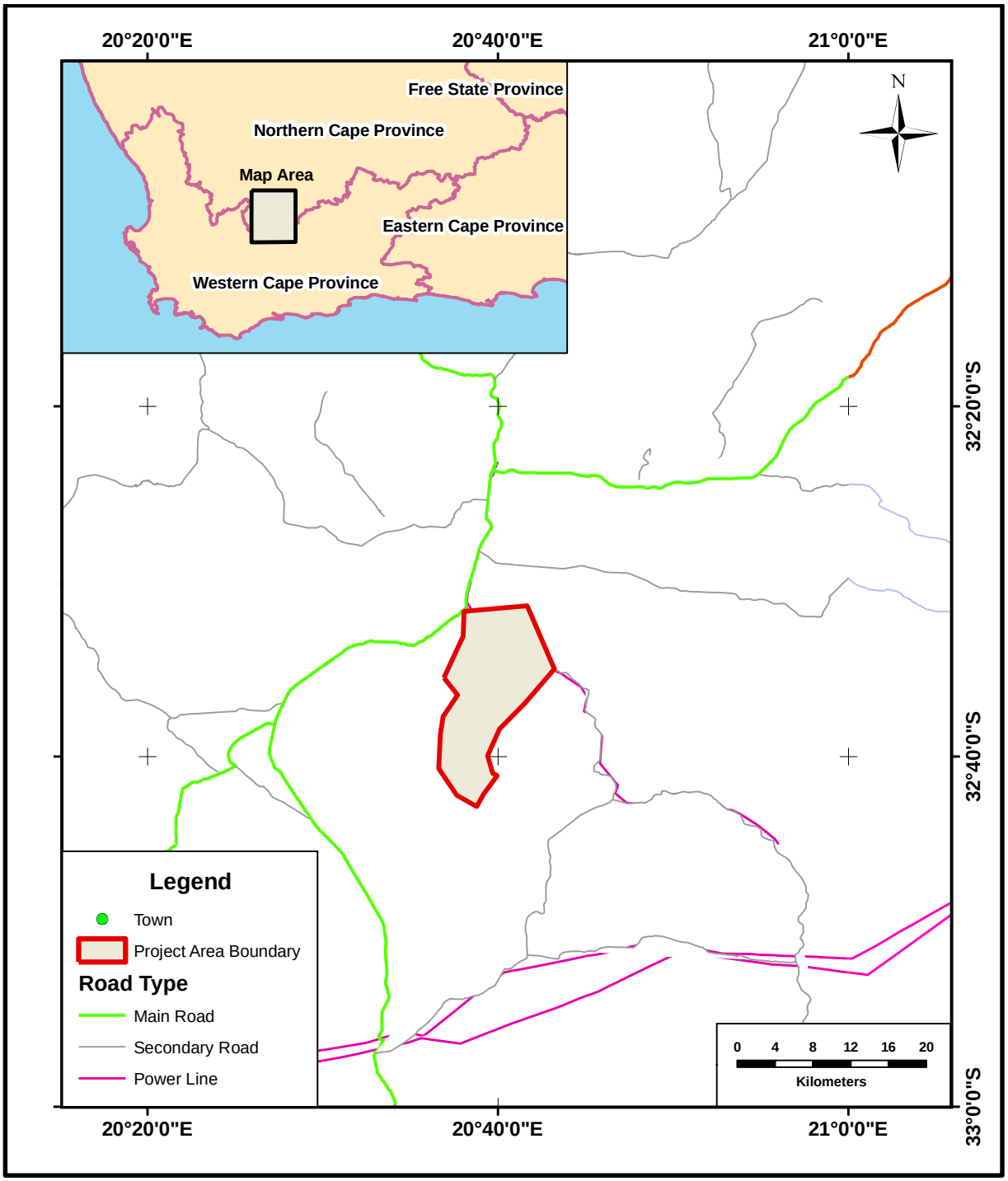

Figure 1: Location map showing the position of the proposed Gunstfontein Wind Farm (Pty) Ltd's energy generation facility.

3 LEGISLATIVE REQUIREMENTS

South Africa's cultural resources are primarily dealt with in two Acts. These are the National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998).

3.1 The National Heritage Resources Act

The following are protected as cultural heritage resources by the National Heritage Resources Act:

- Archaeological artefacts, structures and sites older than 100 years;
- Ethnographic art objects (e.g. prehistoric rock art) and ethnography;
- Objects of decorative and visual arts;
- Military objects, structures and sites older than 75 years;
- Historical objects, structures and sites older than 60 years;
- Proclaimed heritage sites;
- Grave yards and graves older than 60 years;
- Meteorites and fossils; and
- Objects, structures and sites or scientific or technological value.

The Act also states that those heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations must be considered part of the national estate and fall within the sphere of operations of heritage resources authorities. The national estate includes the following:

- Places, buildings, structures and equipment of cultural significance;
- Places to which oral traditions are attached or which are associated with living heritage;
- Historical settlements and townscapes;
- Landscapes and features of cultural significance;
- Geological sites of scientific or cultural importance;
- Sites of Archaeological and palaeontological importance;
- Graves and burial grounds;
- Sites of significance relating to the history of slavery and
- Movable objects (e.g. archaeological, palaeontological, meteorites, geological specimens, military, ethnographic, books etc.).

3.2 Need for Impact Assessment Reports

Section 38 of the Act stipulates that any person who intends to undertake an activity that falls within the following:

- The construction of a linear development (road, wall, power line, canal etc.) exceeding 300 m in length;
- The construction of a bridge or similar structure exceeding 50 m in length;
- Any development or other activity that will change the character of a site and exceed 5 000 m^2 or involve three or more existing erven or subdivisions thereof;
- Re-zoning of a site exceeding 10 000 m^2; and
- Any other category provided for in the regulations of SAHRA or a provincial heritage authority,

The Applicant/ECO on site must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development. If there is reason to believe that heritage resources will be affected by such development, the developer may be notified to submit an impact assessment report. A Palaeontological Impact Assessment (PIA) only looks at the potential impact of the development palaeontological resources of the proposed area to be affected.

3.3 Legislation Specifically Pertinent to Palaeontology*

*****Note: Section 2 of the Act defines "palaeontological" material as "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".

Section 35(4) of this Act specifically deals with archaeology, palaeontology and meteorites. The Act states that no person may, without a permit issued by the responsible heritage resources authority (national or provincial):

- Destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
- Destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
- Trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite;

- Bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment that assists in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites; and
- Alter or demolish any structure or part of a structure which is older than 60 years as protected.

The above mentioned palaeontological objects may only be disturbed or moved by a palaeontologist, after receiving a permit from the South African Heritage Resources Agency (SAHRA). In order to demolish such a site or structure, a destruction permit from SAHRA will also be needed.

Further to the above point, Section 35(3) of this Act indicates that "any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority". Thus, regardless of the granting of any official clearance to proceed with any development based on an earlier assessment of its impact on the Palaeontological Heritage of an area, the development should be halted and the relevant authorities informed should fossil objects be uncovered during the progress of the development.

3.4 The National Environmental Management Act [as amended]

This Act does not provide the detailed protections and administrative procedures for the protection and management of the nation's Palaeontological Heritage as are detailed in the National Heritage Resources Act, but is more general in is application. In particular Section 2(2) of the Act states that environmental management must place people and their needs at the forefront of its concerns and, amongst other issues, serve their cultural interests equitably. Further to this point section 2(4)(a)(iii) states that disturbances of sites that constitute the nation's cultural heritage should be avoided, and where it cannot be avoided should be minimised and remedied.

Section 23(1) indicates that a general objective of integrated environmental management is to identify, predict and evaluate the actual and potential impact of activities upon the cultural heritage. This section also highlights the need to identify options for mitigating of negative effects of activities with a view to minimising negative impacts.

In order to give effect to the general objectives of integrated environmental management outlined in the Act the potential impact on cultural heritage of activities that require authorisation or permission by law must be investigated and assessed prior to their implementation and reported to the relevant organ of state. Thus, a survey and evaluation of cultural resources must be done in areas where development projects that will

potentially negatively affect the cultural heritage. During this process the impact on the cultural heritage will be determined and proposals for the mitigation of the negative effects made.

4 RELEVENT EXPERIENCE

Prof Millsteed holds a PhD in palaeontology and has previously been employed as a professional palaeontologist with the Council for Geoscience in South Africa. He is currently the principle of BM Geological Services and has sufficient knowledge of palaeontology and the relevant legislation required to produce this Palaeontological Impact Assessment Report. Prof Millsteed is registered with the South African Council for Natural Scientific Professions (SACNASP), and is a member of the Palaeontological Society of South African and the Geological Society of South Africa.

5 INDEPENDENCE

Prof Millsteed was contracted as an independent consultant to conduct this Palaeontological Heritage Impact assessment study and shall receive remuneration for these professional services. Neither Dr Millsteed nor BM Geological Services has any financial interest in either Gunstfontein Wind Farm (Pty) Ltd or the proposed power generation facility.

6 GEOLOGY AND FOSSIL POTENTIAL

Figure 2 shows that the project area is completely underlain by Late Permian sediments (the Abrahamskraal Formation) of the Adelaide Subgroup, Karoo Supergroup. The rocks of the Abrahamskraal Formation accordingly form part of the basin fill of the Main Karoo Basin (Figure 3). A schematic stratigraphic column detailing the stratigraphic relationships within the local section of the Karoo Supergroup is shown in Figure 4. A summary of the characteristics of the Abrahamskraal Formation and its fossiliferous potential follows.

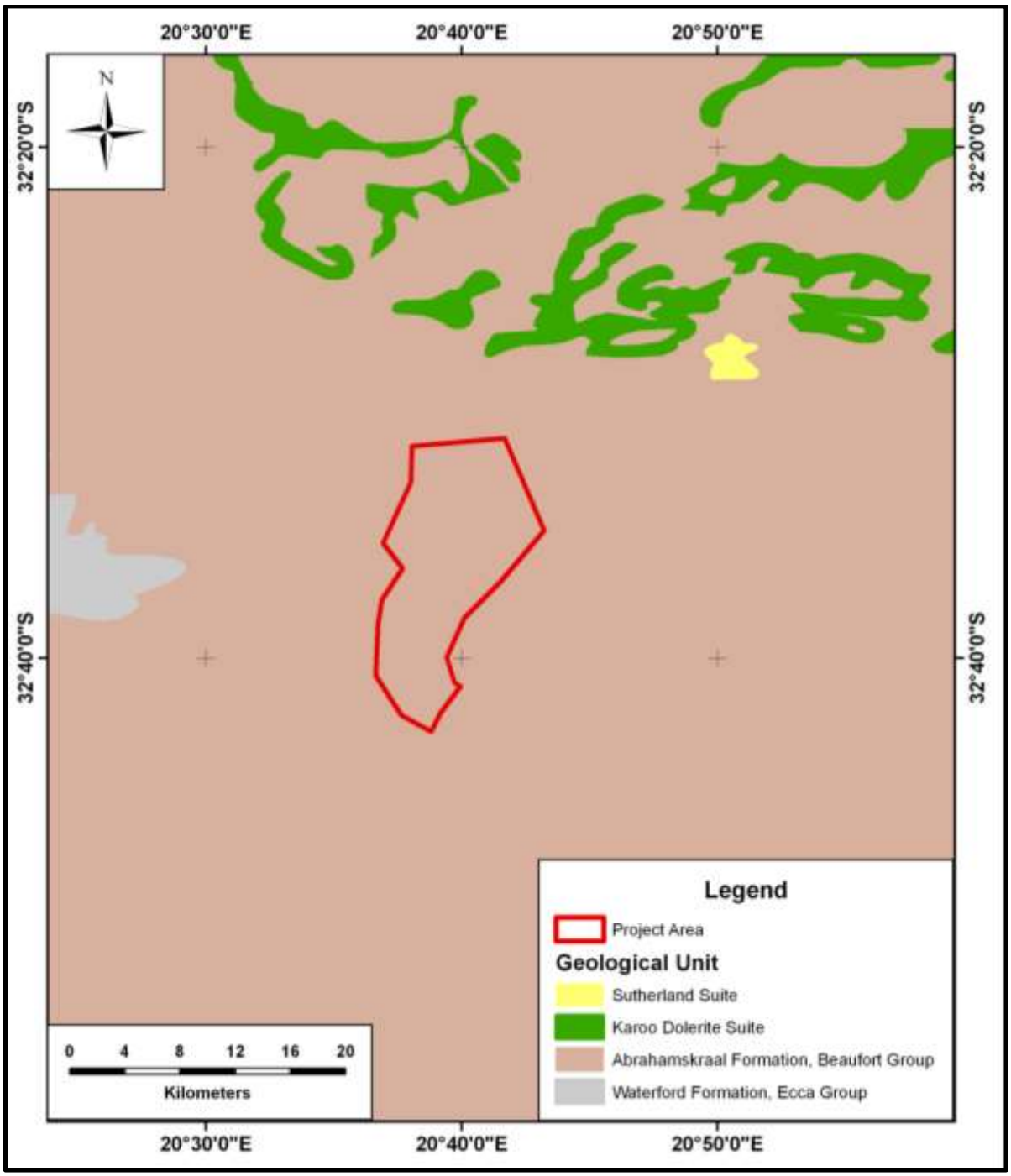

Figure 2: Map of the bedrock geology underlying the project area and its surrounding environs.

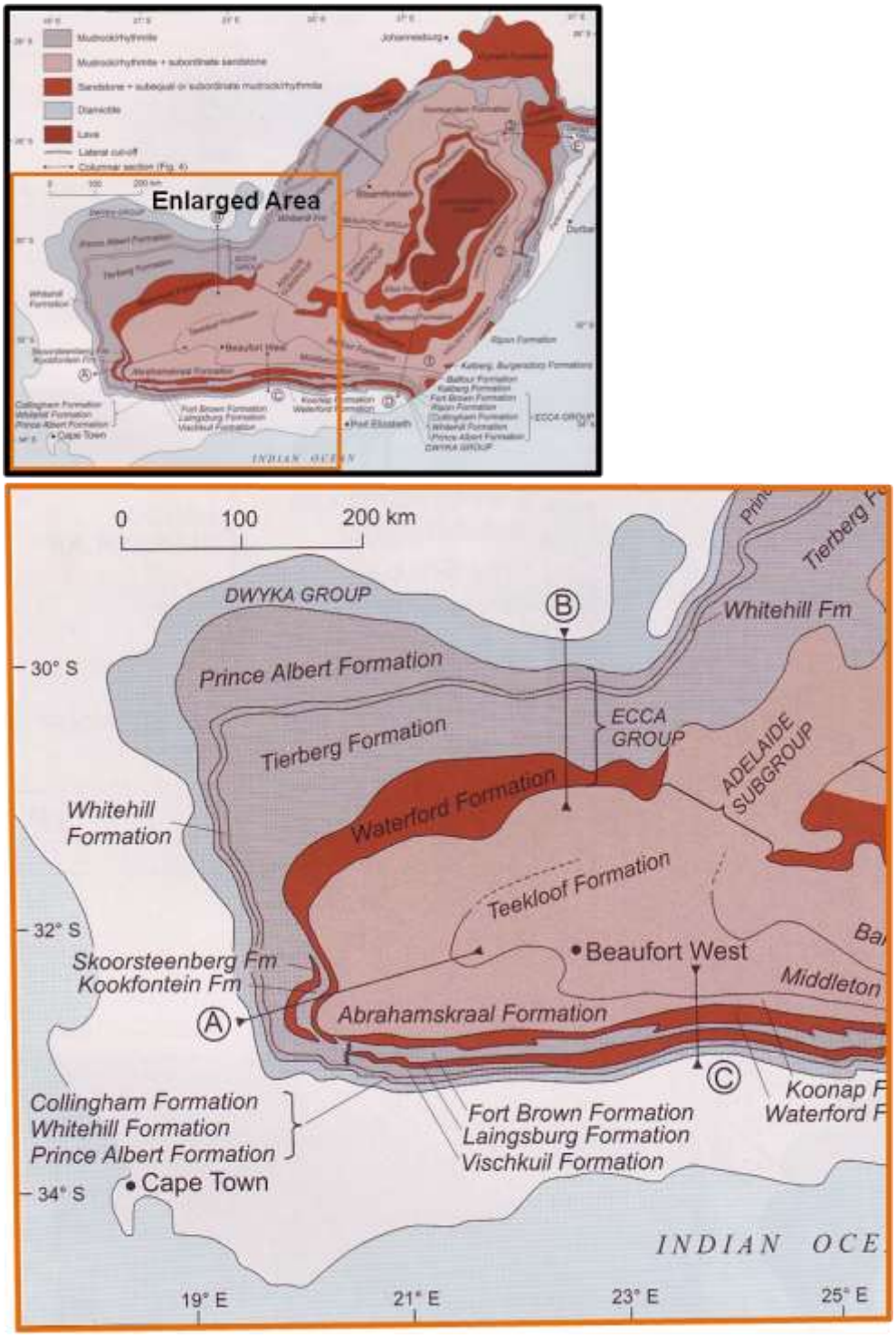

Figure 3: Map of the location of the Main Karoo Basin within South Africa; shown (in the enlarged area) are the outcrop extents of the various stratigraphic units that comprise the basin infill in the southwestern portion of the basin (after Johnson *et al*., 2006).

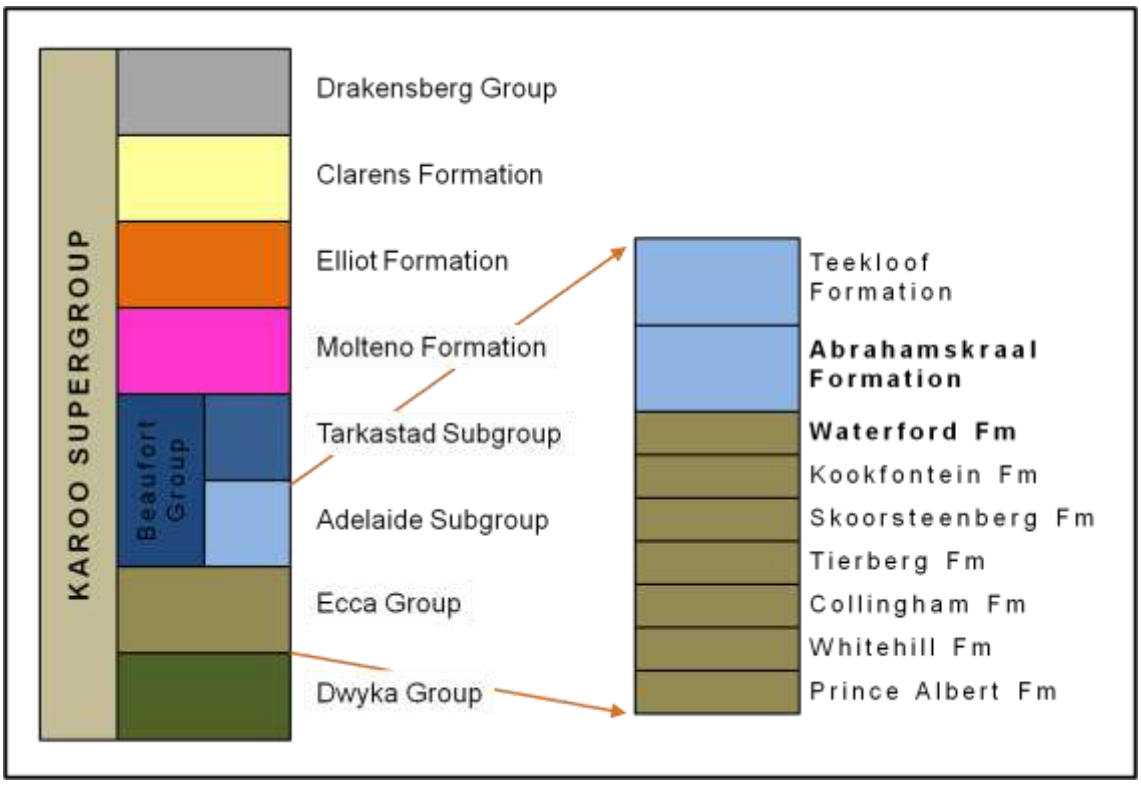

Figure 4: Stratigraphic column of geological units comprising the Karoo Supergroup. The subdivision of the Adelaide Subgroup shown is that applicable to the strata in the southwest of the Main Karoo Basin (i.e., west of 24° of longitude).

6.1 Abrahamskraal Formation

6.1.1 Geology

The Adelaide Subgroup consists of greenish or blue grey and greyish-red mudstones and sandstones (South African Committee for Stratigraphy (SACS), 1980; pp. 538-539). Palaeocurrent data suggests that the bulk of the sediment comprising the Adelaide Subgroup was derived from a source area lying to the south and southeast of the main Karoo Basin (i.e., the uplifted strata of the Cape Fold Belt). The ubiquitous presence of fining-upward cycles within the sediments, a terrestrial biota (see Section 6.1.2 below), red coloured mudrocks and distinctive sedimentary structures indicate that the unit was deposited under fluvial conditions. The high mud/sand ratios and fine-grained character of the sandstones suggests meandering rather than braided rivers (Johnson *et al*., 2006).

The Adelaide Subgroup is differentiated into two distinct stratigraphic sequences which are located either side of the line of longitude of 24° east. To the east of that dividing line the Adelaide Subgroup consists of (in order of decreasing stratigraphic age) the Koonap, Middelton and Balfour Formations. To the west of 24° east the Adelaide subgroup is

subdivided into a lower Abrahamskraal and an upper Teekloof Formations [South African Committee for Stratigraphy (SACS), 1980)]. The project area lies west of the dividing line of longitude and so must form part of the western succession. The Gunstfontein Project area is completely underlain by sediments of the Abrahamskraal Formation (Figure 2).

The Abrahamskraal Formation is distinguished from the overlying Teekloof Formation by the presence of a number of distinctive chert bands (a few centimetres to 2 m in thickness) as well as a higher abundance of red mudstones [South African Committee for Stratigraphy (SACS), 1980]. In practice the boundary between the two units is drawn at the base of the Poortjie Sandstone (a sandstone-rich stratigraphic succession).

6.1.2 Palaeontological potential

The Abrahamskraal Formation sediments of the project area lie within the *Tapinocephalus* Assemblage Zone (Figure 5). The fauna of the *Tapinocephalus* Assemblage Zone include the synapsid reptiles such as Dinocephians (*Anteosaurus*, *Paranteosaurus*, *Titanosuchus*, *Jonkaria*, *Struthiocephalus*, *Struthiocephaloides*, *Struthionops*, *Taurocephalus*, *Avenantia*, *Criocephalus*, *Delphinognathus*, *Moshops*, *Riebeeckosaurus*, *Keratocephalus*, *Mormosaurus*, *Phocosaurus*, *Styracocephalus* and *Tapinocephalus*), dicynodonts (*Galeops*, *Robertia*, *Pristerodon* and *Diictodon*), Biarmosuchia (*Hipposaurus*), theracephalians (*Gianosuchus*, *Alopecodon*, *Scylacosaurus*, *Lyosuchus*, *Blattoidealestes*, *Icticephalus* and *Pristerognathus*), captorhinid reptiles (*Eunotosaurus*, *Bradysaurus*, *Embrithosaurus* and *Broomia*), the pelycosaur reptile *Elliotsmithia*, the amphibian Rhinesuchus and fish (*Namaichthys*, *Atherstonia* and *Elonichthys*) (Smith and Keyser, 1995).

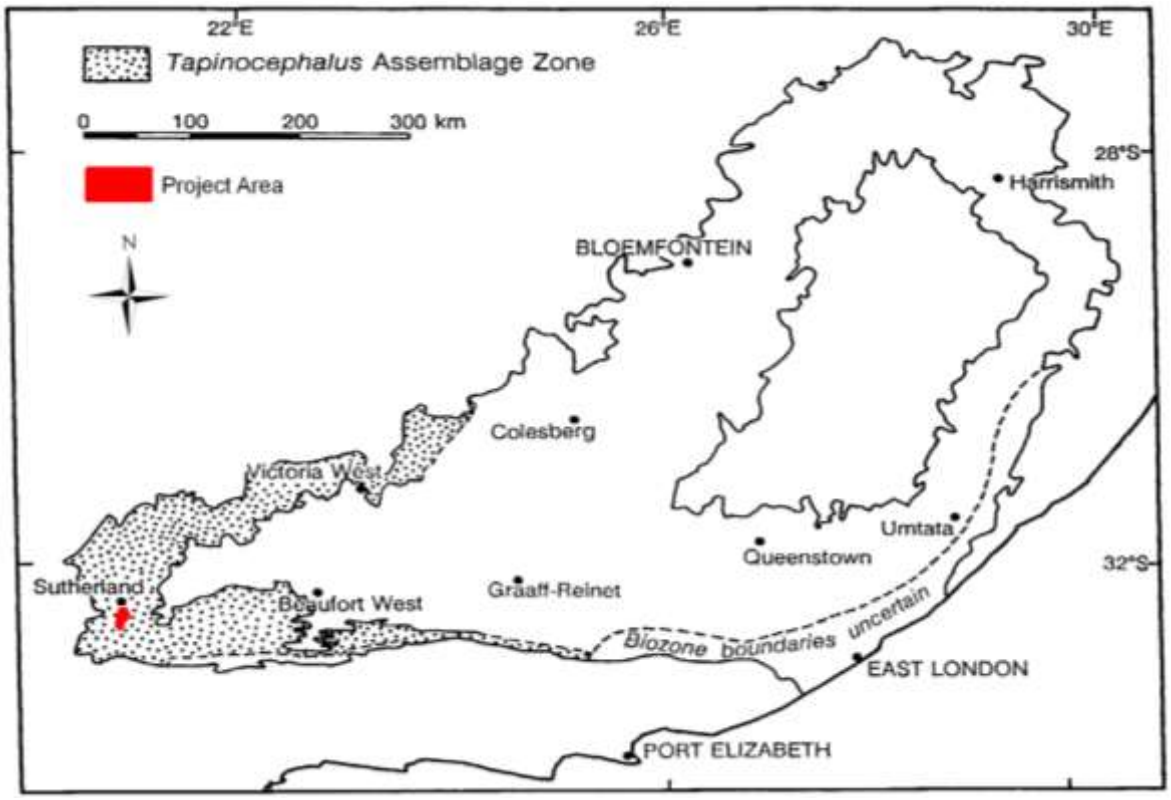

Figure 5: Map of the upper and lower stratigraphic boundaries of the Beaufort Group, Main Karoo Basin. Shown on the map is the aerial extent of the *Tapinocephalus* Assemblage Zone and the location of the project area (after Smith and Keyser, 1995).

Plant macrofossil assemblages associated with the Abrahamskraal Formation are not well documented, but appear to be relatively restricted in terms of taxonomic diversity. Bamford (2004) has reported that the palaeobotanical record of the lower Beaufort Group is dominated by Glossopterids, but they diminish in both diversity and abundance upwards through the Beaufort Group strata. Bamford combined discussion of the stratigraphic section extending from the Volksrust Formation (Ecca Group) up to the top of the Teekloof Formation (top of the Adelaide Subgroup in the southwest of the Main Karoo Basin) as one assemblage. Bamford's compilation of the plant macrofossils present within that combined unit includes mosses (*Buthelezia*), sphenophytes (*Sphenophyllum*, *Raniganjia*, Phyllotheca and *Schizoneura*), a fern (*Sphenopteris*), glossopterids (11 different leaf types and 6 fructifications), a cordaitalean (*Noeggerathiopsis*), wood (*Australoxylon* and *Prototaxoxylon*) and three general of uncertain botanical affinity (*Taeniopsis*, *Pagiophyllum* and *Benlightfootia*). The depositional environments indicated above for the lower Beaufort Group are usually considered to have good potential for growth and fossilization of plant materials; the relatively low taxonomic diversity exhibited by the unit may well be an artefact of under representative sampling (Bamford, 2004).

Abundant fossil insect faunas have been recovered from localities within the Estcourt Formation (now included within the Normandien Formation) in the north-eastern extent of the Main Karoo Basin (Riek, 1973, 1976a, 1976b). The Normandien Formation is the sole formation comprising the Adelaide Subgroup in the north of the basin, but the nature of the stratigraphic relationship with these faunas and the Abrahamskraal Formation is unclear.

7 ENVIRONMENT OF THE PROPOSED PROJECT SITE

The project area is approximately 12 000 Ha in extent. Examination of Google earth imagery of the project area (Figure 6) and topographic contours (Figure 7) suggests that the land surface of the project area predominantly consists of a number of topographic elements. The northern half of the project area consists of an elevated plateau lying between approximately 1 560 m and 1 600 m a.m.s.l. The southern half of the project area consists of a large, approximately northeast-southwest oriented valley. The slopes of the valley are extremely prominent and steep, with the northern slope occupying much of the southern half of the project area and forming part of the Great Escarpment. The majority of the southern slopes of the valley lie outside of the project area. This southern slope forms part of a prominent northeast-southwest oriented spur protruding from the Great Escarpment. There is a well developed ephemeral, dendritic drainage system that drains the slopes of the valley and these drainage lines coalesce along the axis of the valley to form a single, prominent trunk channel predominantly lying below 1 000 m a.m.s.l. This ephemeral trunk channel eventually flows to the north-west where it coalesces with the Tankwa River.

Mucina and Rutherford (2006) indicate that the vegetation cover of the project area consists of three veld types (Figure 8). The northern plateau carries a vegetation cover of the Roggenveld Shale Rhenosterveld veld type. The slope of the southern valley (i.e., the Great Escarpment) are covered by the Tanqua Escarpment veld type and the base of the valley consists of Tanqua Wash Riviere veld type (Figure 8). The conservation status of all three veld types is listed as least threatened by Mucina and Rutherford (2006).

The absence of signs of cultivation within the boundaries of the project area (Figure 6) suggests that the site is utilised for grazing and/or game farming.

Figure 6: Google earth image of the project area (the red polygon) and its environs. It is evident from the image that the northern portion of the project area consists of an elevated plateau. The southern edge of the plateau is defined by the upper edge of the Great Escarpment (white stippled line). The southern portion of the project area consists of a steep sided, valley. There are no signs of cultivation evident from the image and as such it is probable that the area is utilised for grazing and/or game farming.

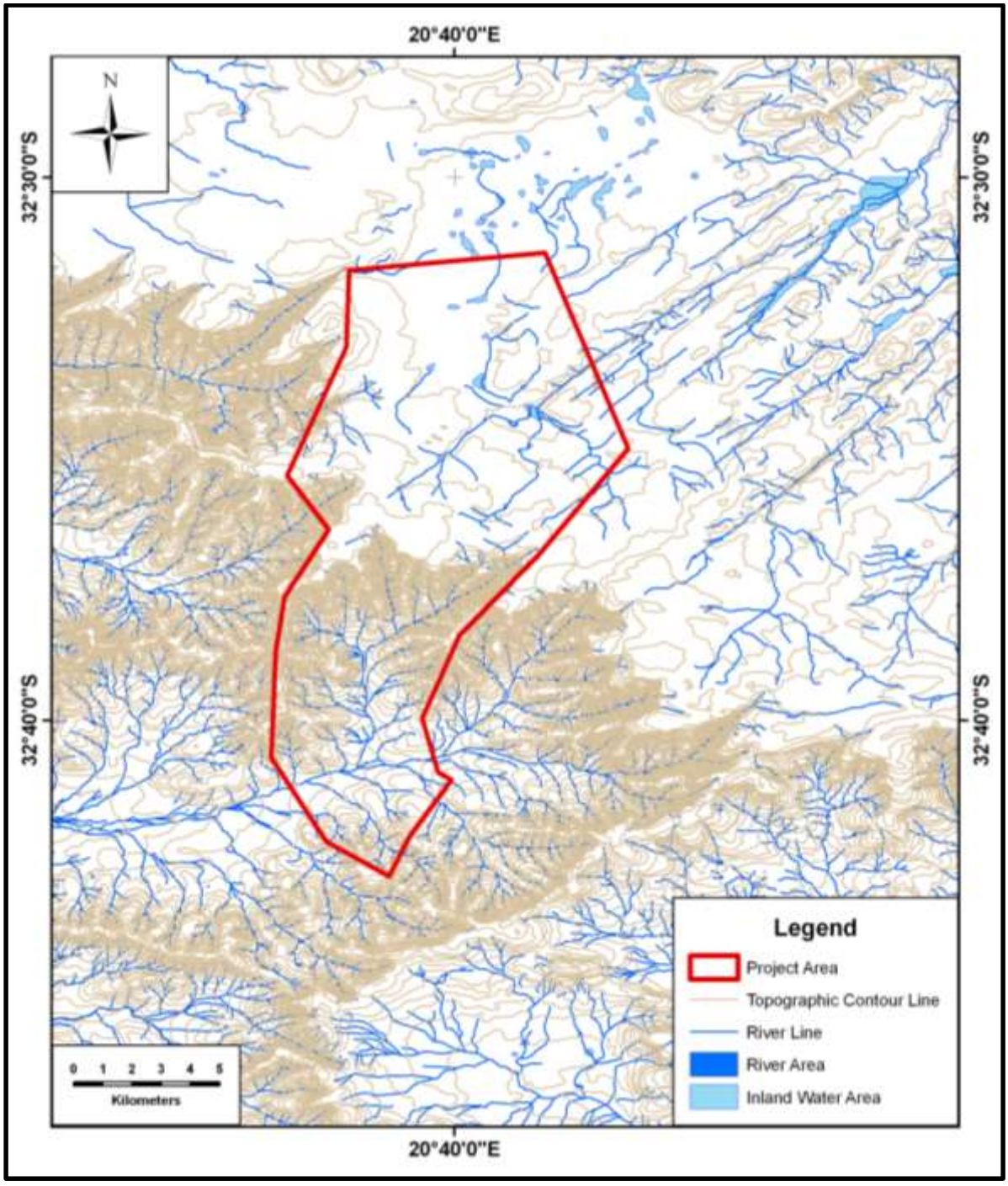

Figure 7: Map of the project area with topographic contours superimposed. It is evident that the project area consists of a northern plateau and a northeast-southwest oriented valley in the south. The boundary between these two topographic features is defined by the top of the Great Escarpment. Located within the southern valley is a distinctly dendritic drainage system. The drainage system flows to the west where it eventually becomes a tributary of the Tankwa River.

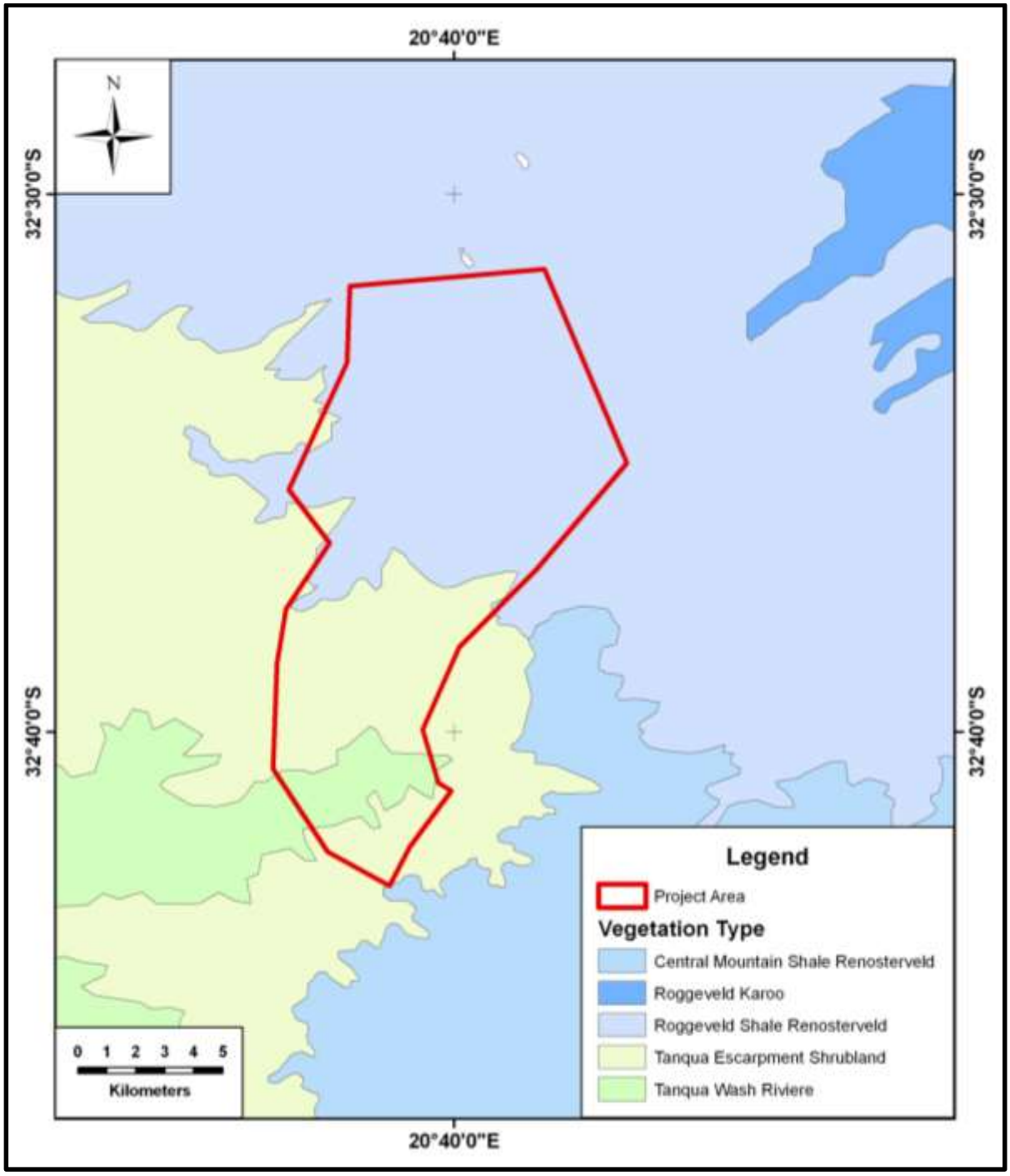

Figure 8: Map of the distribution of the vegetation veld types located within the project area and its surrounding environs (after Mucina and Rutherford, 2006).

8 OVERVIEW OF SCOPE OF THE PROJECT

The proposed power generation project will consists of a wind energy generation facility with an installed capacity of up to 200 MW.

A general overview of the infrastructure required for the facility is as follows:

- Up to 100 wind turbine generators
- Rotors on the turbines will be up to 140 m in diameter
- Hub Height will be up to 120 m
- Wind turbines each up to 4MW in capacity

It is assumed for the purposes of this report (following comparison to similar existing wind farm projects) that the additional construction details will include:

- Permanent concrete foundations to support the turbines, and associated gravelled crane pad/laydown area;
- Cabling between the turbines, to be laid underground where practical and generally alongside the internal access roads, to connect to an on-site substation;
- An on-site substation to facilitate the connection between the wind energy facility and the electricity grid
- Internal access roads to each turbine linking the wind turbines and other infrastructure on the site
- Buildings and dedicated areas for workshops, control systems, maintenance and storage with parking areas where required; and
- Temporary construction compound and temporary site offices.

9 IMPACT ASSESSMENT

The potential impact of Gunstfontein Wind Energy Facility is categorised below according to the following criteria:-

9.1 Nature of Impact

The potential negative impacts of the proposed project on the palaeontological heritage of the area are:

- Damage or destruction of fossil materials during the construction of project infrastructural elements to a maximum depth of those excavations. Many fossil taxa (particularly vertebrate taxa) are known from only a single fossil and, thus, any fossil

material is potentially highly significant. Accordingly, the loss or damage to any single fossil can be potentially significant to the understanding of the fossil heritage of South Africa and to the understanding of the evolution of life on Earth in general. Where fossil material is present and will be directly affected by the building or construction of the projects infrastructural elements the result will potentially be the irreversible damage or destruction of the fossil(s).

- Movement of fossil materials during the construction phase, such that they are no longer *in situ* when discovered. The fact that the fossils are not *in situ* would either significantly reduce or completely destroy their scientific significance.
- The loss of access for scientific study to any fossil materials present beneath infrastructural elements for the life span of the existence of those constructions and facilities.

9.2 Extent of impact

The possible extent of the permanent impact of the proposed project on the palaeontological heritage of South Africa is restricted to the damage, destruction or accidental relocation of fossil material caused by the excavations and construction of the necessary infrastructure elements forming part of the project. The possible source of a less permanent negative impact on the palaeontological heritage is the loss of access for scientific research to any fossil materials that become covered by the various infrastructural elements that comprise the project. The **extent of the area of potential impact is, accordingly, categorised as local** (i.e., restricted to the project site).

9.3 Duration of impact

The anticipated duration of the identified impact is assessed as potentially **permanent to long term**. This is assessment is based on the fact that, in the absence of mitigation procedures (should fossil material be present within the area to be affected) the damage or destruction of any palaeontological materials will be permanent. Similarly, any fossil materials that exist below the structures and infrastructural elements that will constitute the power generation facility will be unavailable for scientific study for the life of the existence of those features.

9.4 Probability of impact

The Abrahamskraal Formation is fossiliferous elsewhere in the Main Karoo Basin and the area under consideration is large (approximately 12 000 Ha); as such there is a reasonable chance of fossil materials occurring within the rocks underlying the project area, however the proposed development will impact less than 5% said area under consideration. It is pertinent to realise that fossils (particularly vertebrate fossils) are generally scarce and sporadic in their occurrence. Similarly, locations containing plant macrofossil assemblages are also uncommon, but differ from vertebrate fossils in that large numbers of fossils tend to be present within the fossil sites. In the case of both vertebrate and plant macrofossils the probability of any development affecting a fossil at any particular point on the land surface consisting of the Abrahamskraal Formation is assessed as **low**.

9.5 Significance of the impact

The scientific and heritage importance of the fossil assemblages known to occur within the Abrahamskraal Formation can be defined as follows. The rocks of the lower Beaufort Group form the lower portion of a stratigraphic succession which is known as the most complete and possibly important stratigraphic sequence in the world which contains fossil assemblages that document the evolutionary transition from reptiles to mammals. The documented plant macrofossil assemblages of the lower Beaufort Group are neither common nor taxonomically diverse. However, there is reason to believe that this situation may to some extent be the result of under sampling of the unit resulting from a lack of research. If the later is true then any plant macrofossil assemblages present within the project area may considerably extend the current understanding of the evolution of plant types and communities within the Late Permian of South Africa. Thus, the fossils of the Karoo-age sequence are an important component of the world's palaeontological and scientific heritage.

The scientific and cultural significance of fossil materials is underscored by the fact that many fossil taxa (particularly vertebrate taxa) are known from only a single fossil and, thus, any fossil material is potentially highly significant. Accordingly, the loss or damage to any single fossil can be potentially significant to the understanding of the fossil heritage of South Africa and to the understanding of the evolution of life on Earth in general. Where fossil material is present and will be directly affected by the building or construction of project infrastructural elements the result will potentially be the irreversible damage or destruction of the fossil(s).

The certainty of the exact *in situ* location of fossils and their precise location within the stratigraphic sequence is essential to the scientific value of fossils. The movement of any fossil material during the construction of the facility that results in the exact original

location of the fossil becoming unknown will either greatly diminish or destroy the scientific value of the fossil.

Thus, while **the probability of a negative impact on the palaeontological heritage contained within the sedimentary strata underlying the project area is categorised as low, the significance of any negative impact posed by the project on the palaeontological heritage is categorised as potentially high** if appropriate mitigation procedures are not put into place.

9.6 Severity / Benefit scale

The proposed project is categorised, herein, as being potentially **beneficial**. This classification is based on the intention that the project will provide a long term benefit to the community in terms of the provision of renewable electricity to an increasingly stressed national power grid. This positive benefit will continue throughout the life of the project. The probability of a negative impact on the palaeontological heritage of the project area has been categorised as low if appropriate mitigation procedures are put into place.

The low likelihood of fossils being directly affected by the planned project must be weighed in conjunction with the severity of any negative impact that may result. Many fossil taxa (particularly vertebrate forms) are known from only a single fossil and, thus, any fossil material is potentially highly significant. This potential significance is highlighted by the fact that the sedimentary rocks of the Abrahamskraal Formation may contain important or unique examples of vertebrate fossils and particularly those of mammal-like reptiles. Similarly, the plant macrofossil assemblages contained within the formation may potentially provide an important window into botanical evolution during a geological period in southern Africa where such information is otherwise uncommon. Thus, it is possible that there are fossils of the highest scientific and cultural significance present within the sediments underlying the project area. Accordingly, the loss or damage to any single fossil or fossil locality can be potentially significant to the understanding of the fossil heritage of South. Thus, **although the likely hood of any disturbance of palaeontological materials is low, the severity of any impact is potentially extremely high**. The possibility of a negative impact on the palaeontological heritage of the area can, however, be minimised by the implementation of adequate damage mitigation procedures. **If damage mitigation is properly undertaken the benefit/severity scale for the project will lie within the beneficial category.**

A potential secondary benefit of the project would be that the excavations resulting from the progress of the project may uncover fossils materials that were hidden beneath the surface exposures and, as such, would have remained unknown to science. If the planned excavations are inspected, while they are occurring, with a view to identifying any possible

palaeontological materials present the possibility would be generated of being able to study and excavate fossil materials that would otherwise be hidden to scientific study.

9.7 Status

Given the combination of factors discussed above**, it is anticipated that as long as adequate mitigation processes are emplaced prior to commencement of the construction phase little to no negative effect on the palaeontological heritage of the area is anticipated**. As the proposed project would supply electricity to the stressed South African national power grid the project is determined as having a **positive status** herein.

10 DAMAGE MITIGATION, REVERSAL AND POTENTIAL IRREVERSABLE LOSS

The degree to which the possible negative effects of the proposed project can be mitigated, reversed or will result in irreversible loss of the palaeontological heritage can be determined as discussed below.

10.1 Mitigation

A thorough field investigation by a palaeontologist prior to the commencement of construction (as part of a Full Palaeontological Impact assessment Study) of the site identified for final development of the wind power generation facilities, would allow a meaningful evaluation of the presence of potentially fossil-bearing strata within the project area. If fossil materials prove to be present, the process would allow the identification of any such fossils that should either be protected completely or could have damage mitigation procedures emplaced to minimise negative impacts.

It is also recommended that a regular examination of all excavations be made while they are occurring. Should any fossil materials be identified, the excavations should be halted and SAHRA informed of the discovery (as per the legal requirements outlined in Section 3.3 above). A significant potential benefit of the examination of the excavations associated with the construction of the project is that currently unobservable fossils may be uncovered. As long as the construction process is closely monitored it is possible that potentially significant fossil material may be made available for scientific study.

Should scientifically or culturally significant fossil material exist within the project area any negative impact upon it could be mitigated by its excavation (under permit from SAHRA) by a palaeontologist and the resultant material being lodged with an appropriately permitted institution. In the event that an excavation is impossible or inappropriate the fossil or fossil locality could be protected and the site of any planned construction moved.

10.2 Reversal of damage

Any damage to, or the destruction of, palaeontological materials or reduction of scientific value due to a loss of the original location is **irreversible**.

10.3 Degree of irreversible loss

Once a fossil is damaged, destroyed or moved from its original position without its geographical position and stratigraphic location being recorded the **damage is irreversible**.

Fossils are usually scarce and sporadic in their occurrence and the chances of negatively impacting on a fossil in any particular area are low. However, any fossil material that may be contained within the strata underlying the project area is potentially of the greatest scientific and cultural importance. Thus, the potential always exists during construction and excavation within potentially fossiliferous rocks for the permanent and irreversible loss of extremely significant or irreplaceable fossil material. This said, many fossils are incomplete in their state of preservation or are examples of relatively common taxa. As such, just because a fossil is present it is not necessarily of great scientific value. Accordingly, not all fossils are necessary significant culturally of scientifically significant and the potential degree of irreversible loss will vary from case to case. The judgement on the significance of the fossil must be made by an experienced palaeontologist.

11 ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

The information provided within this report was derived from a desktop study of available maps and scientific literature; no direct observation was made of the area as result of a site visit. In particular, the discussion of the geological units present within the project area (and as such the basis of understanding the fossiliferous potential of the area) was derived from the published 1:250 000 geological map of the area). The accuracy of 1:250 000 geological maps is often variable; some areas being compiled from air photo interpretation or remote sensing procedures. The possibility of the presence of additional geological units being present within the project area cannot be disregarded.

The geological map 1: 250 000 geological map series 3220 Sutherland (Geological Survey of South Africa, 1983) does not indicate the presence of any Cainozoic regolith cover within the project area. Cainozoic palaeontological sites are occasionally identified within alluvial terraces and dongas throughout South Africa and it may be expected that large mammal bones, dentition, horn cores, micromammal bones and fresh water molluscs may be identified within Cainozoic strata. The absence of regolith indicated on the geological sheet

does is not definitive of its absence in the area and it is possible that such deposits will be present.

Many details concerning the aerial extent and location of the infrastructural elements that will comprise this development will only be finalised after the completion of the Scoping and Environmental Impact Assessment phase. The assumption made in this study is that the final project area will occupy a much reduced surface area than that reported on herein. This assumption is based on comparison to the size of other similar projects being proposed within South Africa.

12 ENVIRONMENTAL IMPACT STATEMENT

A desktop study has been conducted on the site of the proposed construction of a wind power generation facility. This desktop study forms part of a Heritage Impact Assessment Report that is a component of a larger Scoping and Environmental Impact Assessment to identify and assess all potential environmental impacts associated with the proposed project for the area as identified, and propose appropriate mitigation measures in an Environmental Management Programme.

The project site discussed, herein, is relatively large (approximately 12 000 Ha) in size. It is probable that the area that will be affected by the proposed project is considerably smaller; although the final extent of the project area is yet to be finalised. Additionally, any negative impacts to the palaeontological heritage of the region will be limited to the footprint area of the construction of the projects infrastructural elements that are constructed within the project area. The extent of any impact is accordingly characterised as local. Anticipated, herein, is that most infrastructural elements will only directly affect the surface of the site to a relatively shallow depth, although the maximum depth of the constructions is unknown at the time of compilation of this report. Any fossil materials that remain undiscovered after the construction of the project and which are located beneath the maximum depth of the anticipated excavations will only be negatively affected in so far as they will be unavailable for scientific study for the life expectancy of the infrastructural elements that comprise the project.

This study has identified that the geological unit that underlies the project area is fossiliferous elsewhere in the Main Karoo Basin and, as such, fossils are potentially present and may be negatively impacted. The fossil assemblages contained within the Abrahamskraal Formation are of high scientific and cultural significance. In addition, the rocks of the lower Beaufort Group are known to contain plant macrofossil assemblages and insect faunas elsewhere in the Main Karoo Basin.

There is a potential for negative impact on the palaeontological heritage of the project area throughout the majority of its extent, but the potential risk is categorised as low due to the generally scarcity of fossils in the geological record. However, the fossils that may be anticipated to be present within these units are potentially highly significant to the cultural and scientific heritage of South Africa and the world. As such, the risk of a negative impact is low, but the significance of any negative impact on the fossil assemblages could potentially be very high. Any damage that occurs to such fossil material during the excavation and construction phase of the project would be permanent and irreversible.

The potential negative impact to the palaeontological heritage of the area can be minimised by the implementation of appropriate mitigation processes. A thorough site investigation of the outcrops of the area prior to commencement of the project by a palaeontologist would make it possible that scientifically and/or culturally significant fossils, present within the area may be discovered that would be otherwise damaged, destroyed or inadvertently moved. A secondary advantage of such an investigation would be that any fossil materials located could prove to have a positive effect on the understanding of the fossil record of South Africa and positively affect the palaeontological heritage of the country. Similarly, a thorough and ongoing examination should be made of all excavations as they are being performed. Should any fossil materials be identified, the excavations should be halted and SAHRA informed of the discovery.

The social benefits of the project have been classified as beneficial, herein, as the project aims to provide a renewable source of energy to the South Africa power grid. The power generation capacity of South Africa is presently under significant pressure. **This desktop study has not identified any palaeontological reason to prejudice the progression of this project, subject to the stipulated mitigation programs being put in place**.

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