DESKTOP PALAEONTOLOGICAL HERITAGE IMPACT ASSESSEMENT REPORT ON THE SITE OF PROPOSED SOLAR AND WIND ENERGY GENERATION FACILITIES (STORMBERG PROJECT) TO BE LOCATED ON VARIOUS FARMS NEAR STERKSTROOM, EASTERN CAPE PROVINCE

Prepared for:

Savannah Environmental (Pty) Ltd

On Behalf of:

Networx Eolos Renewables (Pty) Ltd

Prepared By:

Dr B.D. Millsteed

EXECUTIVE SUMMARY

Networx Eolos Renewables (Pty) Ltd proposes to construct a 150 MW photovoltaic solar energy facility (to be completed in two phases), a 450 MW wind power generation facility to be instituted in various phases and a 132 KV power line to connect the power generation facilities to the ESKOM power grid. The project is proposed to be located within numerous farms on a site located approximately 12 km north-east of Sterkstroom and 25 km east of Molteno, Eastern Cape Province. The site occupies an area of approximately 15 770 Ha.

Networx Eolos Renewables (Pty) Ltd has appointed Savannah Environmental (Pty) Ltd, as independent consultants, to undertake a 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 ("EMP"). Savannah Environmental (Pty) Ltd 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.

The final location and extent of the project infrastructural elements is unknown at the time of compilation of this report and will only be finalised after the completion of the Scoping Study Phase of the Environmental Impact Assessment Program.

The majority of the project area is underlain by rocks of the Molteno, Elliot and Clarens Formations as well as Caenozoic regolith. It is known that elsewhere in the Main Karoo Basin these rock units are fossiliferous and it can be anticipated that they contain fossils within the project area. The exposures of the Karoo Dolerite Suite located in the centre of the eastern extent of the project area are not potentially fossiliferous.

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 Molteno, Elliot and Clarens Formations as well as the Caeinozoic regolith is low due to the genera scarcity and sporadic nature of fossils within the geological record. However, the vertebrate faunas contained within the Elliot and Clarens Formations are potentially significant in documenting the evolutionary transition from reptiles to mammals as well as the early evolution of dinosaurs within Gondwana. The plant macrofossil assemblages contained within the Molteno Formation provide a window into the botanical record of the Triassic 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 within karst infill deposits 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. There is no potential for any negative impact on the rocks of the Karoo Dolerite Suite.

The project has been assessed as being socially beneficial herein as it would provide renewable energy to a 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 by a palaeontologist prior to commencement of the project as part of a full EIA study**. 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 thorough 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 adequate mitigation programs being put in place.

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1. INTRODUCTION

Networx Eolos Renewables (Pty) Ltd has identified a site for the establishment of their Stormberg Renewable Energy Project, a development comprising of separate wind and solar energy facility components. In addition, Networx Eolos Renewables (Pty) Ltd is also applying for environmental authorisation for the grid connection infrastructure which includes 132 KV power lines allowing connection of the proposed power generation facilities to the ESKOM power grid. The site identified for the proposed development is located approximately 12 km north-east of Sterkstroom and 25 km east of Molteno within the Magisterial Districts of Molteno, Sterkstroom and Wodehouse, the Inkwanca and Maletswai Local Municipalities, Eastern Cape Province (Figure 1).

The site occupies an area of approximately 15 770 Ha and is located wholly within Section 5 of the farm Leeuwe Fontein 24 Portion 5; Section 5 (Langlaagte) of the Farm Nooitgedacht No.25; the remainder of Section 1 of the farm Nooitgedacht 25; Section 9 of the farm Nooitgedacht 25; Remainder of the farm Nooitgedacht 152; Portion 2 of the farm Nooigedacht 154; Remainder of Portion 1 of the farm Drooge Fontein 155; Remainder of the Farm Drooge Fontein No. 151; Portions 5 and 6 of the farm Schilder Krantz 177; Portion 3 of the farm Jansen Fontein 178; the farm Gelegen Fontein 179; Remainder of the farm Valsch Fontein 180; Portions 0, 1, 2, 3 and remainder of the farm Pen Hoek 181; Portions 6, 9, 10, 11, 12 and remainder of the farm Stones Beacon 187; Portion 2 of the farm Schoemans Kraal 188; Portion 6 of the farm De Boulogne 176 and Portions 0, 2, 3 and 5 of the farm Klip Plaat 22.

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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.

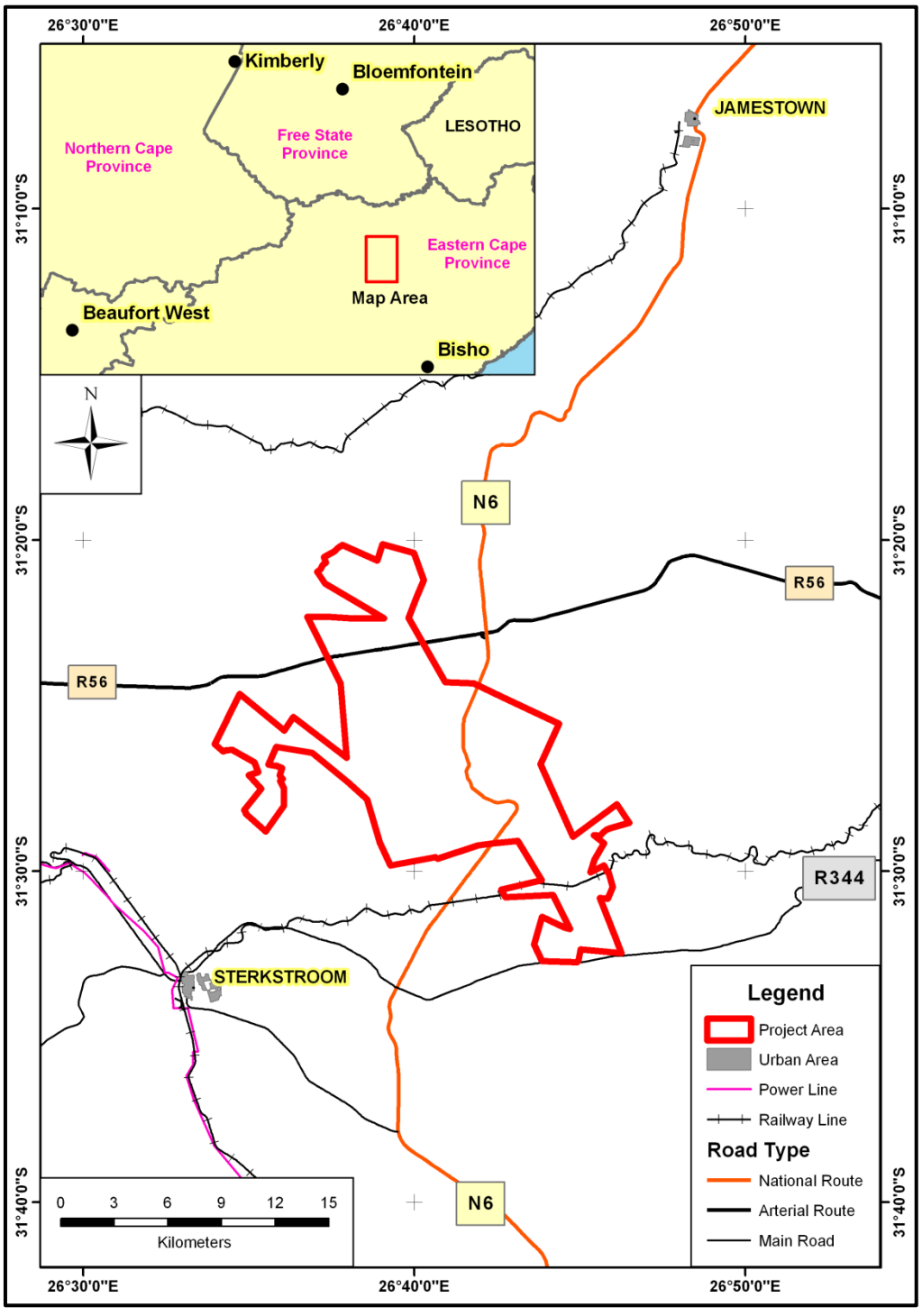

Figure 1: Location map showing the position of the proposed Networx Eolos Renewables (Pty) Ltd's solar and wind energy generation facility.

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,
- 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,
- Movable objects (e.g. archaeological, palaeontological, meteorites, geological specimens, military, ethnographic, books etc.).

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

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 50m 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,
- Any other category provided for in the regulations of SAHRA or a provincial heritage authority.

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; or

- 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,
- 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

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 will be performed. 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

Dr 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. Dr 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

Dr 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 Networx Eolos Renewables (Pty) Ltd or the proposed power generation facilities.

6. GEOLOGY AND FOSSIL POTENTIAL

Figure 2 shows that the project area is completely underlain by Mesozoic sediments (the Molteno, Elliot and Clarens Formations) of the Karoo Supergroup and dolerite igneous intrusive rocks of the Karoo Dolerite Suite. A schematic stratigraphic column showing detailing the stratigraphic relationships within the Karoo Supergroup is shown in Figure 3. There are also areas of Cainozoic-age regolith present within the northern and southern portions of the project area (Figure 4). A summary of the characteristics of each geological unit (discussed in order of decreasing geological age) and their fossiliferous potential follows.

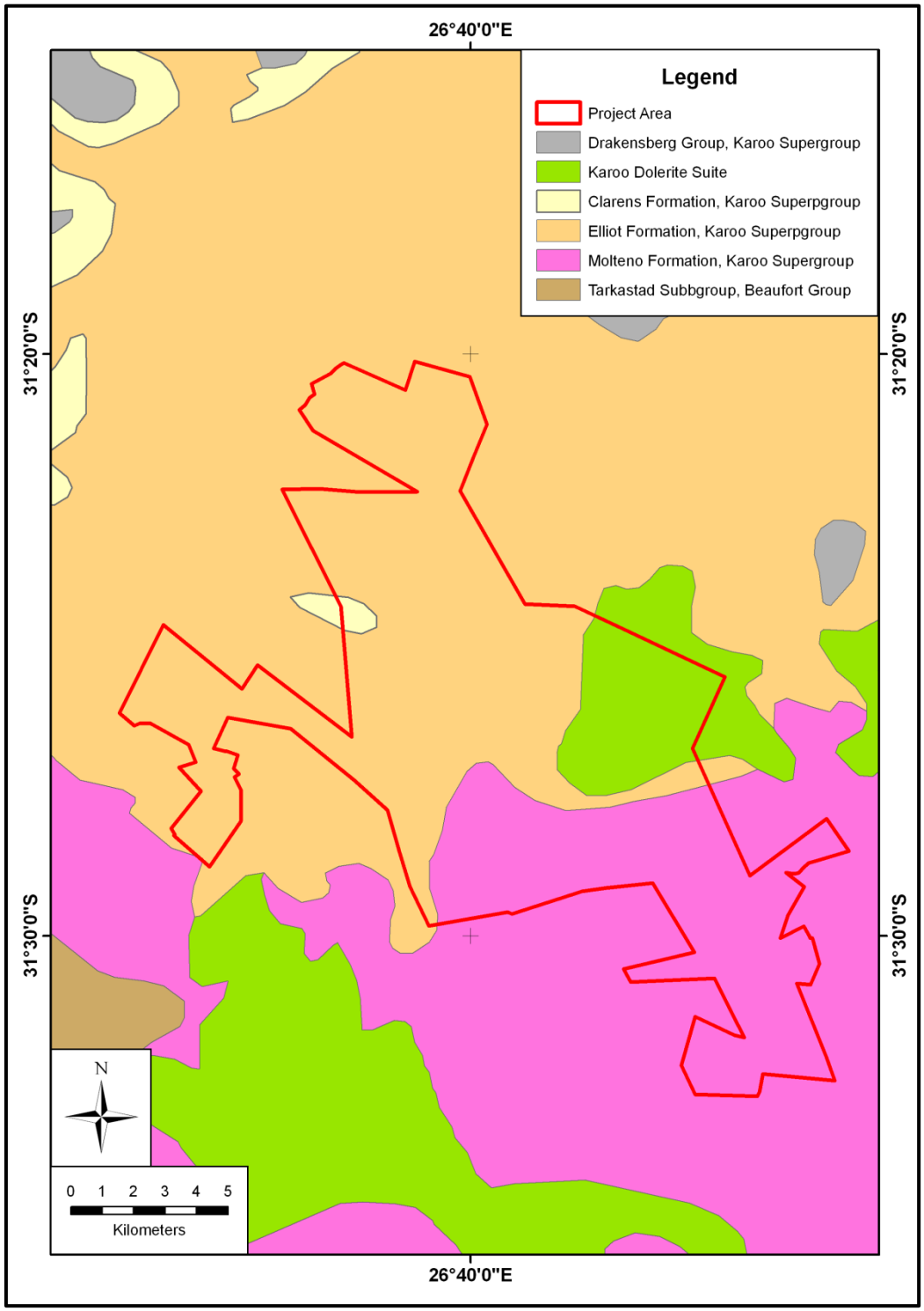

Figure 2: Map of the bed rock geology underlying the project area. The majority of the area is underlain by exposures of the Molteno and Elliot Formations. A small exposure of Clarens Formations is located near the north-western boundary and of non-fossiliferous dolerite in the centre of the eastern boundary.

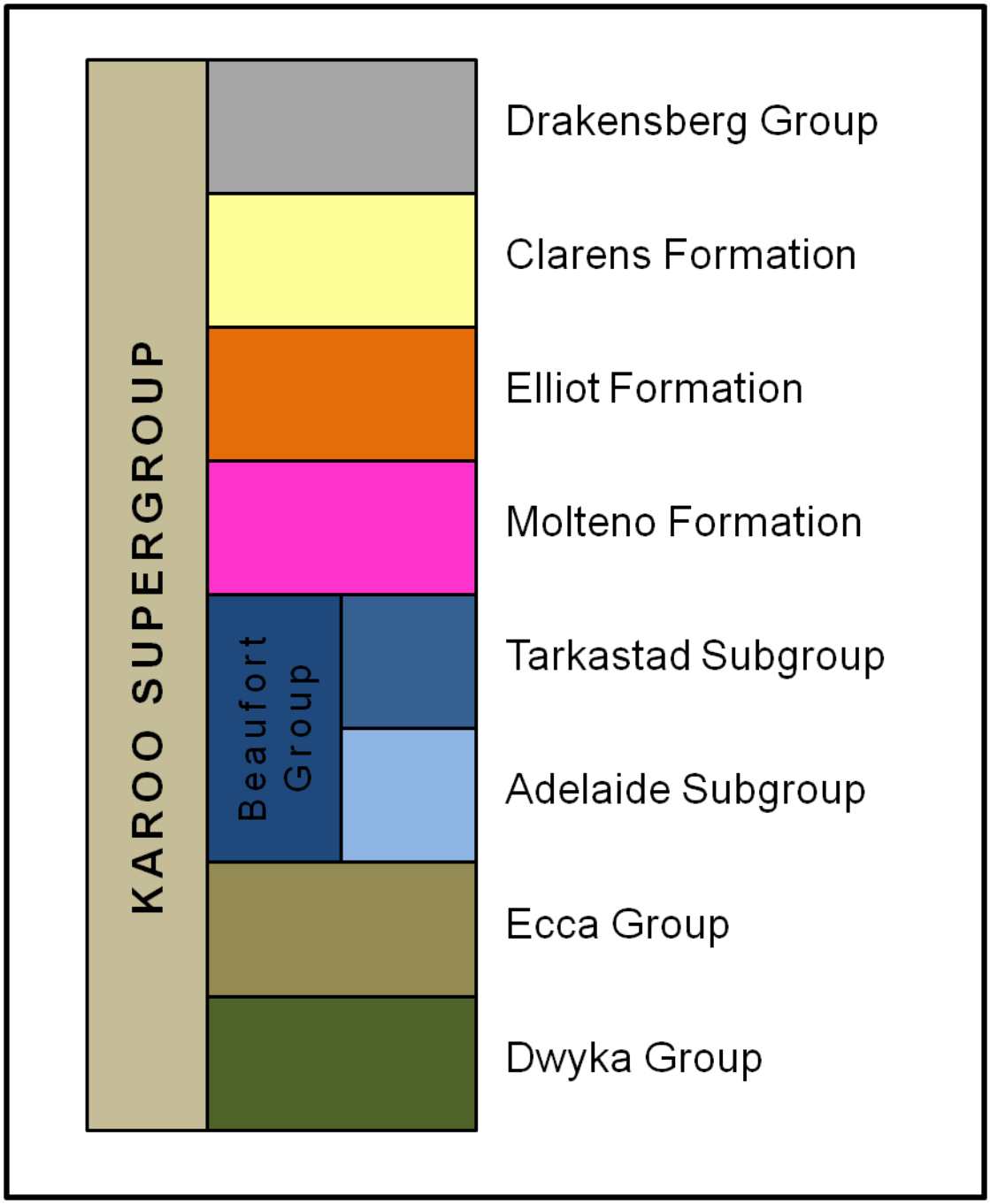

Figure 3: Schematic stratigraphic column of the rocks comprising the Karoo Supergroup.

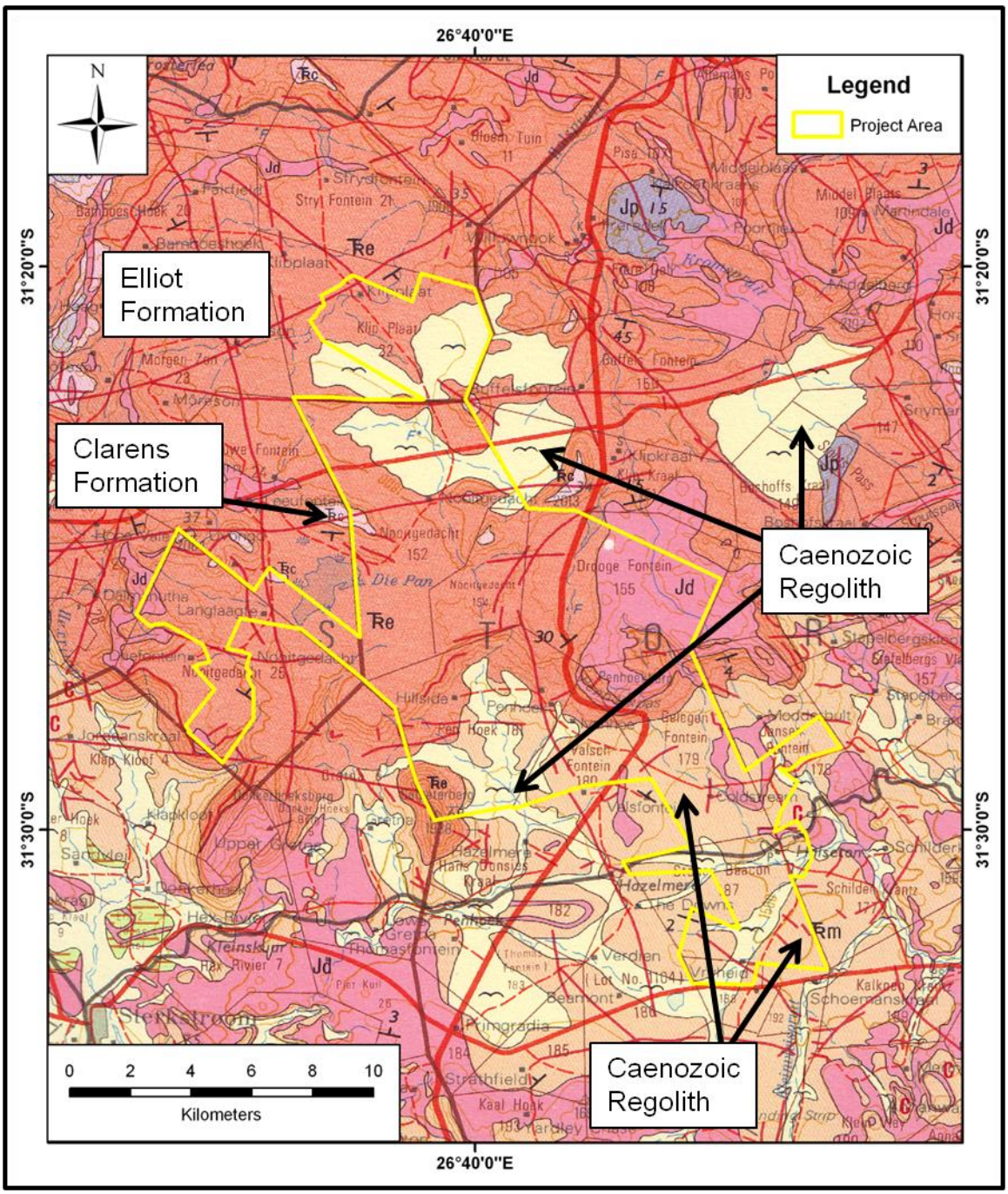

Figure 4: Map of the surface geology of the project area (yellow polygon) and its immediate environs. It is evident that the project area is underlain by sedimentary rocks of the Molteno, Elliot and Clarens Formations. Located in the northern and southern portions of the area are exposures of Cainozoic-age soils (modified from Geological Survey of South Africa 1: 250 000 geological map series 3126 Queenstown).

6.1 Molteno Formation

7.1.1 Geology

The Late Triassic Molteno Formation consists of a maximum thickness of approximately 600 m of alternating medium- to coarse-grained sandstones and grey mudstones. The grains comprising the sandstones tend to have secondary quartz overgrowths that given then a distinctive glittering appearance. The sequence also contains sporadic coal seams, which are indicative of prolific plant growth during the formation of the coals. The formation is subdivided into five members, these being from the base of the formation upwards the Bamboesberg, Indwe Sandstone, Mayaputi, Quiba and Tsomo Members (Johnson *et al*., 2006; Figure 5).

Deposition of the formation was primarily within braided rivers derived from a tectonically active source area situated to the south and southeast (i.e., the uplifted strata of the Cape Fold Belt) (Johnson *et al*., 2006).

6.1.2 Palaeontological potential

The Molteno Formation contains numerous known plant macrofossil localities containing the extremely diverse *Dicroidium* Flora (Anderson and Anderson, 1983 & 1985; Figure 6). The *Dicroidium* Flora is known to contain representatives of mosses (*Marchanites* and *Muscites*), sphenophytes (*Phyllotheca*, *Neocalamites*, *Scizoneaura* and *Equisetites*), ferns (*Todites*, *Asterotheca*, *Cladophlebis* and *Dictyophyllum*), seed ferns (*Dicroidium*, *Lepidopteris*, *Yabiella*, *Taeniopteris* and *Dejerseya*), cycads (*Pseudoctenis*), bennettitaleans (*Nilssoniopteris*), ginkos (*Ginkoites* and *Sphenobaiera*), conifers (*Rissika*, *Voltziopsis*, *Heidiphyllum* and *Gonttriglossa*) and gymnosperms (*Yabiella*, *Jungites*, *Gontriglossa*, *Linguifolium* and *Saportaea*) (Bamford, 2004).

It is apparent from Figure 6 that multiple plant macrofossil sites are known to occur within the immediate region of the project area. It is possible that plant macrofossil localities may be present within the project area. The formation is also known to contain fossil insect faunas (Cairncross *et al*., 1995).

6.2 Elliot Formation

6.2.1 Geology

The Late Triassic Elliot Formation consists of an alternating of mudrock and subordinate fine- to medium-grained sandstones up to 500 m thick in the south of its outcrop area. The mudrocks sequences are red and green-grey in colour and dominate the sequence

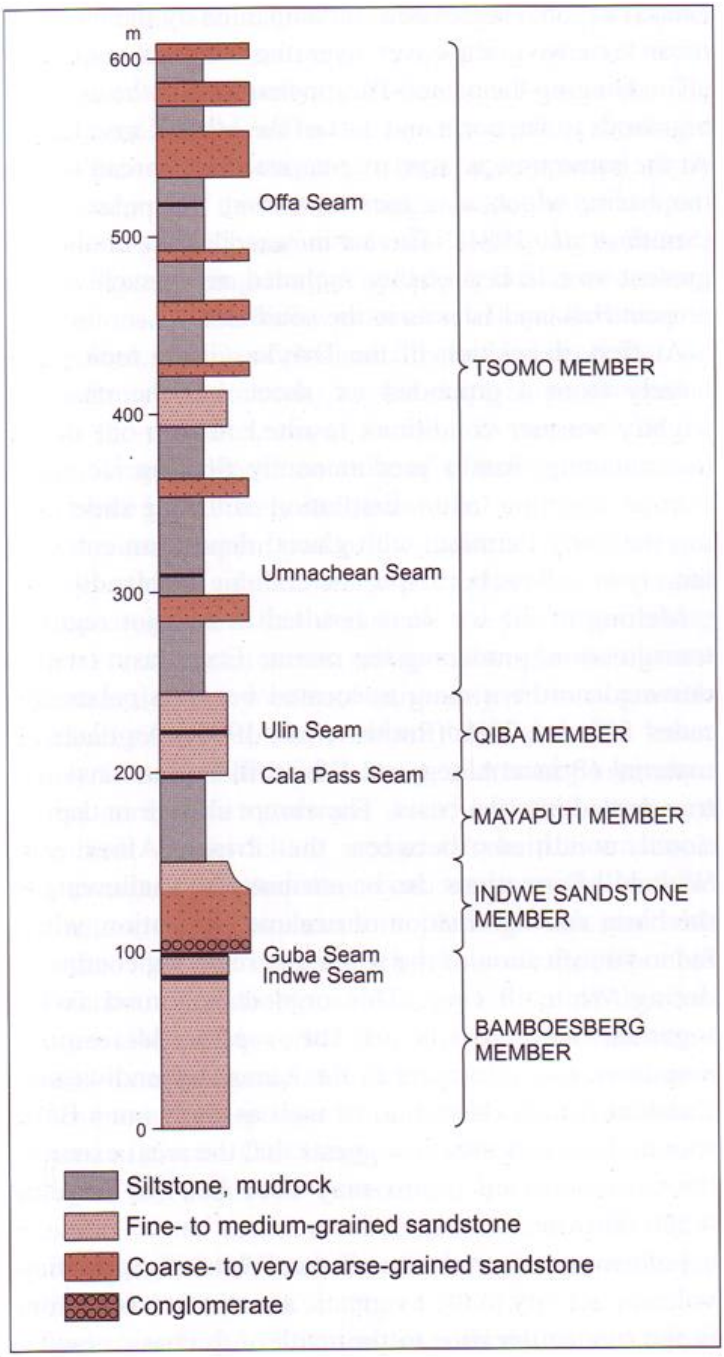

Figure 5: Typical stratigraphic section of the Molteno Formation (Johnson *et al*., 2006). The coal seams present within the sequence are evidence of prolific plant growth during deposition of the unit.

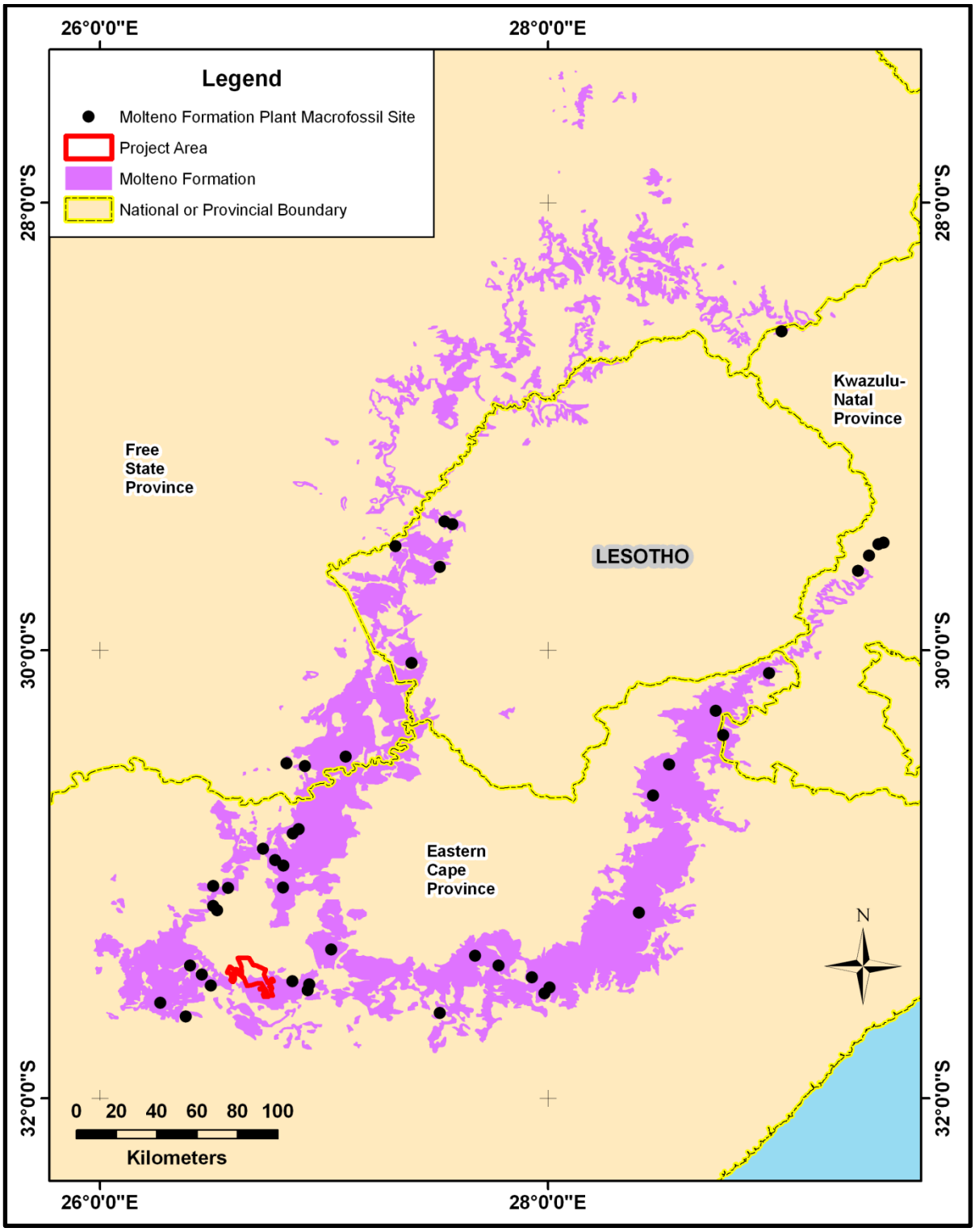

Figure 6: Map showing the distribution of outcrop of the Molteno Formation within South Africa. Indicated are the locations of plant macrofossil localities known to occur within the Molteno Formation (after Anderson and Anderson, 1985).

being 25 m – 100 m thick in the type area, while the yellowish-grey to pale red sandstones are thinner (generally 6-15 m and up to 22 m thick) (Johnson *et al*., 2006).

Depositionally the sequence is a typical red bed fluvial sequence. Initially deposition was within meandering channels, but the rivers became broader, shallower and more ephemeral higher in the unit. Near the top of the formation the sandstones the sandstones represent sheet sands deposited in large fans (Visser and Botha, 1980).

6.2.2 Palaeontological potential

The strata of the Elliot Formation contain a varied vertebrate fauna containing cynodonts (*Scalenodontoides*, *Trytylodon*, *Pachygenelus* and *Tritheledon*), dinosaurs (*Euskelosaurus*, *Syntarus*, *Massospoldylus*, *Fabrosaurus*, *Lycorhinus*, *Lanasaurus, Fabrosaurus, Lesothosaurus, Heterodontosaurus, Eucnemesaurus* (=*Aliwalia*) and *Abrictosaurus*), thecodonts (*Sphenosucus,* Rauisuchids and Pedeticosaurids), crocodilia (*Orthosuchus* and *Baroqueosuchus*), amphibians (Capitosurids and a brachyopid), a turtle (a *proganochelyid*) and dinosaur eggs (Kitching and Raath, 1984; Weishampel *et al*., 1990). A diverse assemblage of vertebrate footprints has also been identified within the unit (Olsen and Gaulten, 1884).

The plant macrofossil assemblages present within the Elliot Formation are much rarer, less well understood and considerably less diverse than those of the underlying Molteno Formation. Plant genera known to occur within the formation include representatives of the sphenophytes (*Equisetites*), bennettialeans (*Otzmites*), conifers (*Sphenolepidium* and *Pinus*), a genus of uncertain affinity (*Phoenicopsis*) and the fossil woods (*Agathoxylon*, *Podocarpoxylon* and *Rhexoxylon*) (Bamford, 2004).

6.3 Clarens Formation

6.3.1 Geology

The Late Triassic/Early Jurassic Clarens Formation is composed almost completely of predominantly cream coloured, massive, well-sorted, fine-grained sandstones consisting of well-rounded quartz grains. Most of the sandstone is considered to be aeolian in origin, but there is a minor component of the formation (particularly near the base of the unit) that consists of coarse-grained, detrital material deposited by ephemeral streams (Johnson *et al*., 2006).

6.3.2 Palaeontological potential

Significant fossils assemblages, but less diverse than those identified within the underlying Elliot Formation, have been reported within this unit and its lateral equivalents throughout South Africa and southern Zimbabwe. The vertebrate fossil

assemblages of the Elliot Formation include dinosaurs (*Aristosaurus, Fabrosaurus, Geranosaurus, Gyposaurus, Heterodontosaurus, Hortalotarsus, Massospondylus and Thecodontosaurus*), sinapsid reptiles (*Pachygenelus and Tritylodon*) and a mammal (*Erythrotherium*) (Haughton, 1924; Raath, 1969; South African Committee for Stratigraphy (SACS), 1980; Olsen and Galton, 1984; Kitching and Raath, 1984; Weishampel *et al*., 1990). There have also been at least 10 different types of vertebrate footprints identified within the Clarens Formation and its lateral equivalents within South Africa (Van Dijk *et al*., 1978; Olsen and Galton, 1984).

Plant macrofossil fossils are uncommon with the formation and the assemblage is restricted to a single genus of sphenophyte (*Equisetum*) and the fossil wood *Podocarpoxylon* (Bamford, 2004).

These fossil (both plant and vertebrate) assemblages are uncommon and sporadic in their occurrence, but this rarity means that each fossil that does exist is potentially extremely scientifically significant.

6.4 Karoo Dolerite suite

6.4.1 Geology

The intrusive dolerite rocks of the Karoo Dolerite Suite are present throughout the Main Karoo Basin as a series of dykes and sills. These Jurassic dolerites (emplaced approximately 183 ± 2 Ma) represent the remnants of the feeder system to the flood basalt eruptions that forms the lavas of the Drakensberg Group that cap the Drakensberg Mountains (Duncan and Marsh, 2006).

6.4.2 Palaeontological potential

The rocks of the Karoo Dolerite Suite are derived from the solidification of molten magma within the subsurface of the Earth. These rocks accordingly, have no palaeontological potential.

6.5 Cainozoic Regolith

6.5.1 Geology

Much of the northern and southern sections of the project area have a cover of alluvium. The type and thickness of this regolith cover is generally unavailable. However, in the southern portion of the project area the exposures of alluvium are lenticular and appear to be related to the position of ephemeral drainage lines draining the escarpment running through the centre of the project area. These southern Caeonozoic materials would appear to have been fluvially deposited.

6.5.2 Palaeontological Potential

Cainozoic age palaeontological sites are occasionally identified in alluvial terraces and dongas throughout South Africa. It may be expected that large mammal bones, dentition, horn cores, micromammal bones and fresh water molluscs may be identified within strata of this age.

7. ENVIRONMENT OF THE PROPOSED PROJECT SITE

The project area is approximately 15 770 Ha in extent. Examination of Google Earth imagery of the project area (Figure 7) and topographic contours (Figure 8) suggests that the land surface of the project area predominantly consists of two planar regions separated by an approximately east-west oriented escarpment running through the centre of the area. A number of prominent hills are located along the northern margin of the site and another is located within the south-western extent of the area.

Mucina and Rutherford (2006) indicate that the vegetation cover of the project area consists of three veld types (Figure 9). The east-west oriented escarpment that runs through the the project area has a cover of Southern Drakensburg Highland Grassland and the region north of the escarpment is covered by Stormberg Plateau Grassland; collectively they comprise part of the more extensive Drakensberg Grassland veld type. The area south of the base of the escarpment is vegetated with Tsomo Grassland (part of the more extensive Sub-escarpment Grassland veld type). The conservation status of the Tsomo Grassland is classified as vulnerable, while the Stromberg Plateau and Southern Drakensburg Highland Grassland are classified and least vulnerable by Mucina and Rutherford (2006).

The absence of signs of cultivation within the boundaries of the project area (Figure 7) suggests that the site is utilised for grazing and/or game farming.

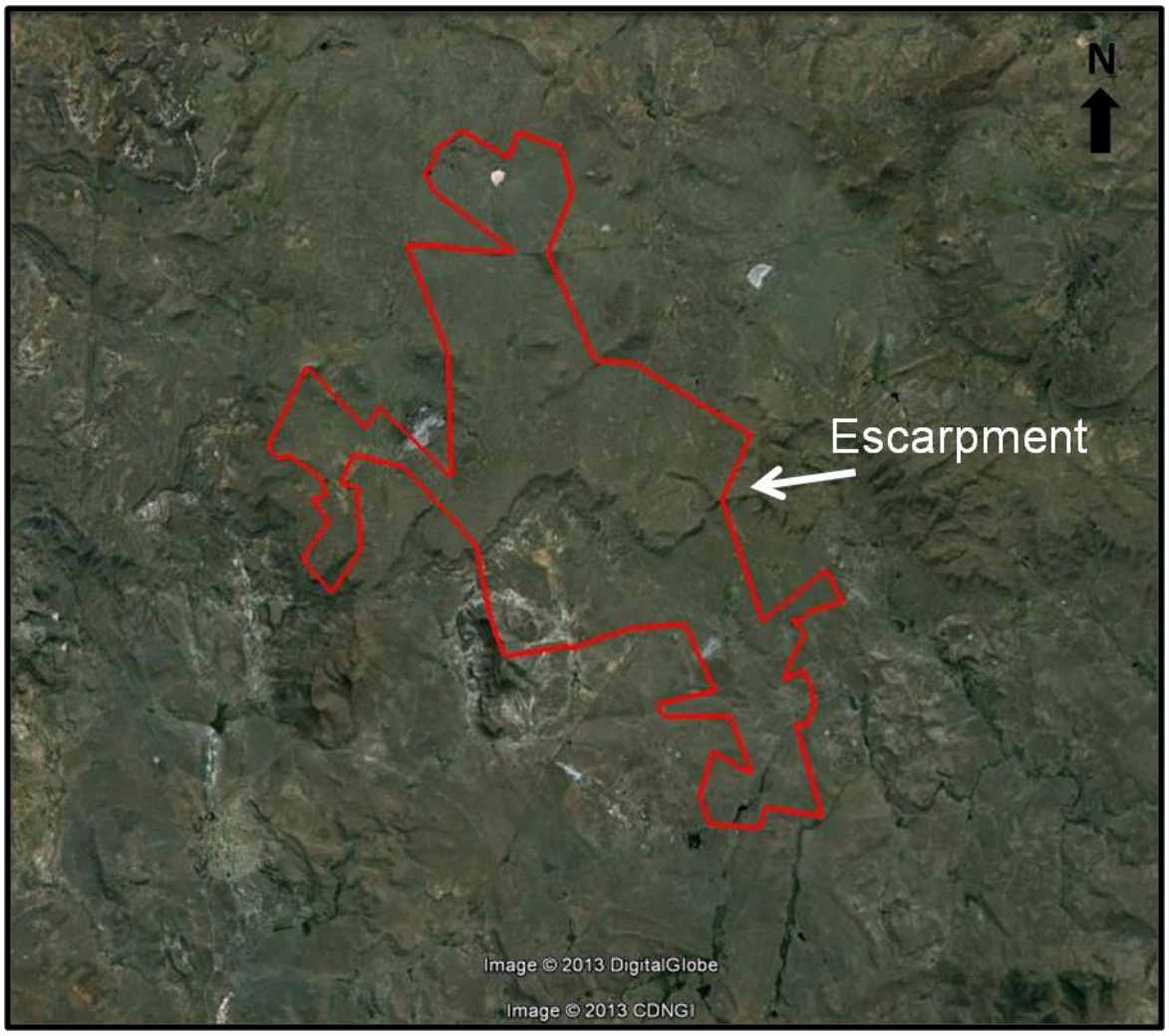

Figure 7: Google Earth image of the project area (the red polygon) and its environs. It is evident from the image that the project area is divided into northern and southern portions by an escarpment. The areas lying to the north and west of the escarpment are plains, with the southern area lying at lower altitudes. 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.

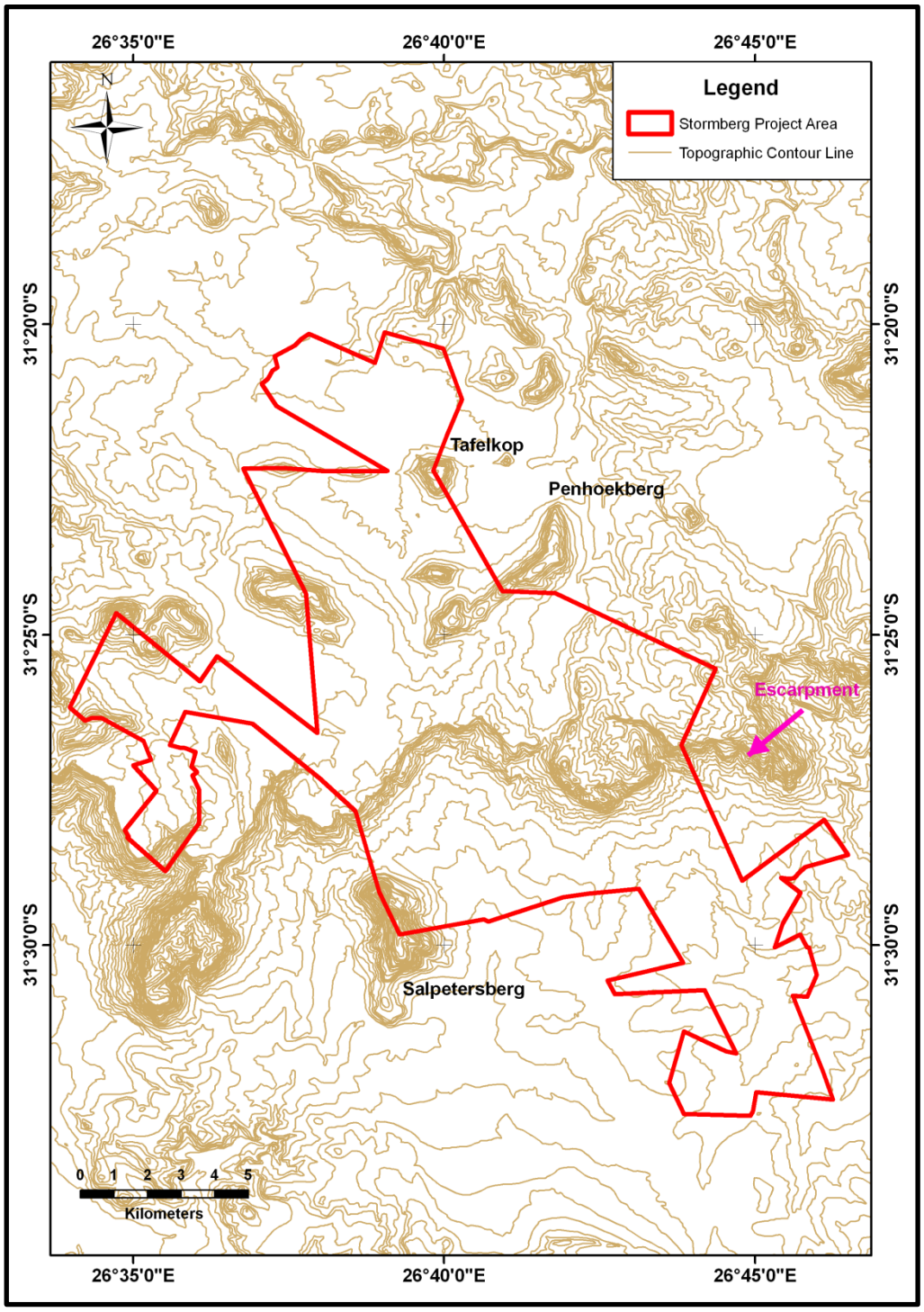

Figure 8: Map of the project area with topographic contours superimposed. It is evident that the project area consists of two distinct plains (occurring at different altitudes) which are separated by a prominent east-west oriented escarpment. Several prominent hills are present in the northern extent of the project area.

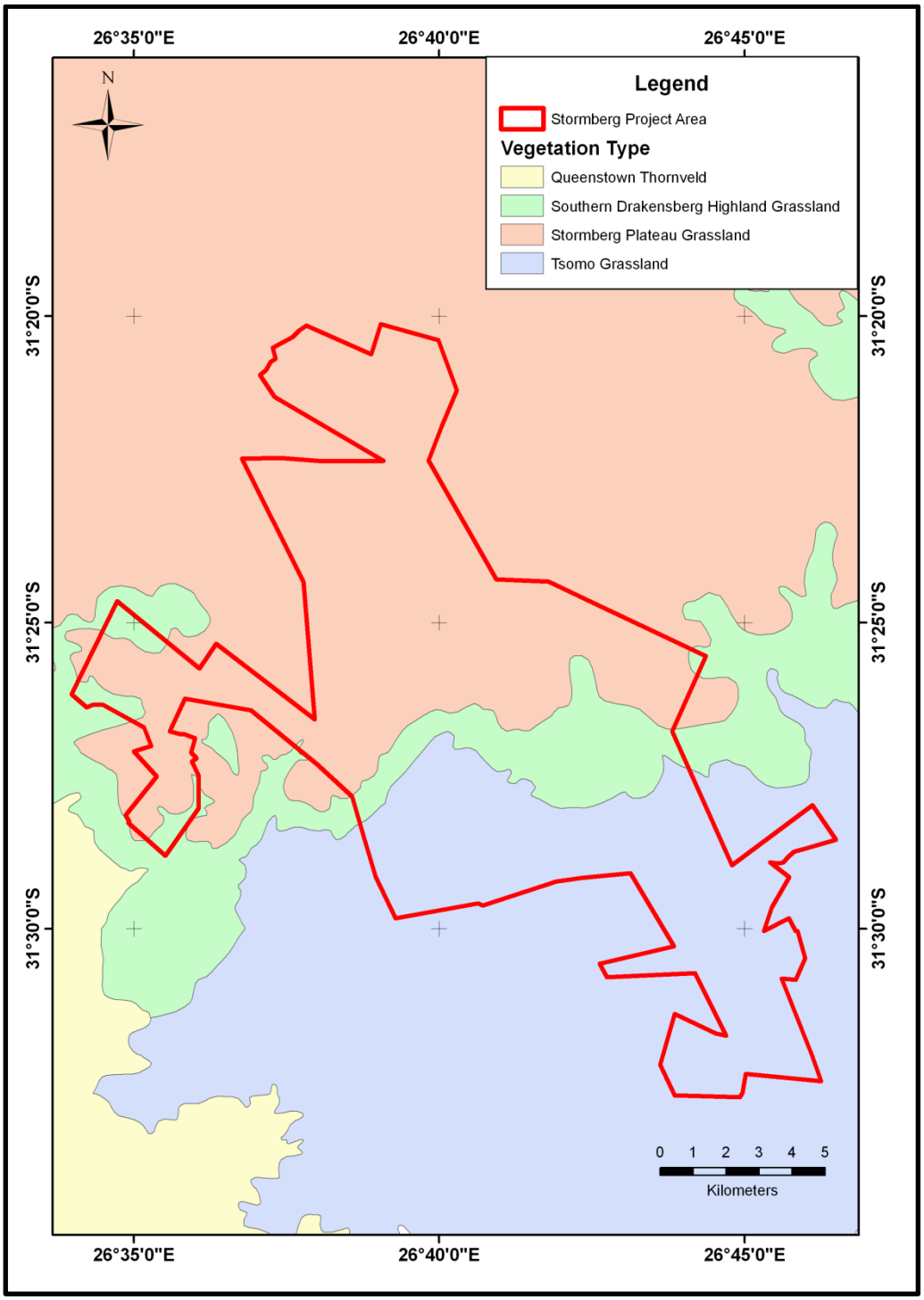

Figure 9: Map of the distribution of vegetation types within the project area and its environs (after Mucina and Rutherford, 2006).

8. OVERVIEW OF SCOPE OF THE PROJECT

The proposed power generation project will consists of a separate wind and solar energy generation facilities as well as corridors for the construction of a 132 KV power line to connect to Eskom's grid facility.

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

8.1 Solar Energy Facility

The Photovoltaic facility is proposed to have a total generating capacity of up to 150 MW and is to be developed in two phases.

Infrastructure associated with the solar energy facility is proposed to include:

- Photovoltaic (PV) panels on a mounting structure, with a capacity of up to 150 MW and respective inverter stations;
- A new on-site substation to facilitate the connection between the solar energy facility and the electricity grid, including a building for control and storage;
- Cabling between the above mentioned infrastructures, to be laid underground where practical;
- Internal access roads and fencing.

8.2 Wind energy Facility

The facility will comprise of up to up to 150 turbines with a generating capacity of up to 3.5 MW each, with a hub height of up to 120m and a rotor diameter of up to 130 m. The wind energy facility would have a capacity of up to 420 MW and is to be developed in progressive stages. Infrastructure associated with the wind energy facility is proposed to include:

- Wind turbines up to 3.5 MW in capacity;
- Concrete foundations to support the turbines;
- Cabling between the turbines, to be laid underground where practical, will connect to an on-site substation;
- An on-site substation to facilitate the connection between the wind energy facility and the electricity grid, including a building for control and storage;
- Internal access roads to each turbine linking the wind turbines and other infrastructure on the site.

8.3 Proposed Power lines

For the first phase of the Stormberg Renewable Energy Project, two alternative corridors are being investigated for the construction of a 132 KV power line to connect to Eskom's grid:

- Option A is proposed from the Stormberg Renewable Energy Project to the existing Komani Substation (located near Queenstown).
- Option B is proposed from the Stormberg Renewable Energy Project to the existing Freemantle Substation (located near Lady Frere).

For the second phase of the Stormberg Renewable Energy Project, a 132 KV power line corridor will be investigated to connect to the Eskom transmission network located to the west of the Stormberg Renewable Energy Project between Molteno and Sterkstroom.

A corridor of up to 500 m in width will be considered for each power line alternative. The most environmentally and technically feasible alternatives for connection will be identified through the EIA process.

The extent of the vertical disturbance of the regolith and/or bedrock profile that can be anticipated by this project has not been specified.

9. IMPACT ASSESSMENT

The potential impact of Networx Eolos Renewables (Pty) Ltd's solar and wind power generation facilities 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 less permanent possible source of a 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 Molteno, Elliot and Clarens Formations and the Caenozoic regolith are fossiliferous elsewhere in the Main Karoo Basin and the area under consideration is large (approximately 15 770 Ha); as such there is a reasonable chance of fossil materials occurring within the rocks underlying the project area. It is pertinent to realise that fossils (particularly vertebrate fossils and footprints) are generally scarce and sporadic in their occurrence. Similarly, locations containing plant macrofossil assemblages are also rare, 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 outcrops of the Molteno, Elliot and Clarens Formations or exposures of Caenozoic regolith is assessed as **low**.

The rocks of the Karoo Dolerite Suite are the product of solidification of molten magma within the Earth's crust and are unfossiliferous. Accordingly, the proposed project and its infrastructure pose have **nil** probability of any negative impact to the palaeontological heritage of the project area.

In accordance with the above discussion points **the probability of any negative impact on the palaeontological heritage of the area is categorised as low over most of the area and as nil within the Karoo dolerite exposures**.

9.5 Significance of the impact

The rocks of the upper Karoo Supergroup (i.e., the Elliot and Clarens Formations) are known as an extremely significant stratigraphic section because its fossil content documents the later stages of the evolutionary transition from reptiles to mammals. Similarly, it is an important section as it documents a significant portion of the early evolution of Gondwanan dinosaur evolution. The Molteno Formation is known to contain diverse and scientifically significant assemblages of plant macrofossils that document the status of botanical evolution during the Triassic. 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 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 Elliot and Clarens Formation may contain important or unique examples of mammal-like reptile, early mammal, amphibian or early dinosaur fossils. Similarly, the plant macrofossil assemblages contained within the Molteno Formation 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 regolith and, as such, would have been lost to science. If the planned excavations are inspected, while they are occurring, with a view to identifying any possible palaeontological materials or karst infill deposits present the possibility would be generated to be 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 as part of a full EIA study prior to the commencement of construction, of the site identified for final development of the solar and wind power generation facilities as well as the proposed power line, 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 close 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. 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.

There are significant deposits of Cainozoic age strata present to the west and south of 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. Examination of the available data for project site does not indicate that there are strata of this age present within the project area, but their presence remains a possibility. The presence of fluvial terraces in the area is not unknown.

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 solar and 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 (15 770 Ha) in size. It is probable that the area that will be affected by the proposed project is considerably smaller; the final extent of the project area is yet to be finalised. Thus, the extent of any impact is characterised as local. In addition, to the aerial extent of the impact any negative effects emanating from the project will be restricted to the local environment of the final development area. It is anticipated, herein, 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 all of the geological units that underlie the project area (except for the rocks of the Karoo Dolerite Suite) are potentially fossiliferous. The rocks of the Molteno Formation are known to contain significant plant macrofossil assemblages and insect faunas. The sediments of the Elliot and Clarens Formations and the Caenozoic regolith contain scientifically significant vertebrate and vertebrate foot print fossils throughout their outcrop extents within the Main Karoo Basin.

There is a potential for negative impact on the palaeontological heritage of the project area throughout it's 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 occurring to such fossil material that occurs during the excavation and construction phase of the project would

be permanent and irreversible. In the area lying on the central eastern margin of the area which is underlain by rocks of the Karoo Dolerite Suite there is nil risk of a negative impact.

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. As such **this desktop study has not identified any palaeontological reason to prejudice the progression of this project, subject to adequate mitigation programs being put in place**.

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Dr B.D. Millsteed

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