DESKTOP PALAEONTOLOGICAL IMPACT ASSESSMENT REPORT ON THE SITE OF THE MERCEDES-BENZ SOUTH AFRICA'S PROPOSED NEW PROVING GROUND TO BE LOCATED ON THE FARM STEENKAMPS PAN 419 PORTION 6, APPROXIMATELY 38 KM NE OF UPINGTON, IN THE NORTHERN CAPE PROVINCE

11 July 2015

Prepared for:
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On behalf of:
Mercedes-Benz South Africa

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Prepared for:

WSP Environmental (Pty) Ltd

On Behalf of:

Mercedes-Benz South Africa

Prepared By:

Prof B.D. Millsteed

EXECUTIVE SUMMARY

Mercedes-Benz South Africa is proposing to establish a new vehicle proving ground facility. The project area is proposed to be located within the farm Steenkamps Pan 419 Portion 6 and occupies an area of approximately 3 750 ha. The project site is located approximately 38 km northeast of Upington, //Khara Hais Local Municipality, Northern Cape Province (Figure 1).

WSP Environmental (Pty) Ltd has been appointed by the General Planner IngenAix GmbH on behalf of Mercedes Benz South Africa to undertake an Environmental Impact Assessment Process and compile an Environmental Management Programme (EMPr) for the project. WSP Environmental (Pty) Ltd has appointed BM Geological Services to provide a desktop Palaeontological Heritage Impact Assessment Report in respect of the proposed.

The potential negative effects of the required construction operations upon the geological strata underlying the project area will be restricted to the bedrock strata comprising the Proterozoic Leerkrans Formation, Koras Group and potentially also the Blauwkrans Granite. The Cenozoic Kalahari Group forms an extensive superficial cover sequenced over much of the project area and appears to consist of a layer of calcrete which is immediately overlain by aeolian sand of the Gordonia Formation (the latter often being present as NW-SE oriented sets of linear sand dunes).

The Leerkrans Formation, Koras Group, Blauwkrans Granite and the calcretes of the Kalahari Group are all classified as being unfossiliferous herein. Accordingly, both the probability of the project resulting in a negative impact on the palaeontological heritage of these four units assessed as nil, as is the potential significance of any negative impact.

The aeolian sands of the Gordonia Formation are potentially fossiliferous, but the potential for any negative impacts upon the palaeontological heritage are low. However, scientifically highly significant fossil assemblages are known to be present within sediments coeval with the Gordonia Formation elsewhere within the Northern Cape Province. Thus, 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. As such, the risk of a negative impact is low, but the significance of any negative impact on the fossil assemblages could potentially be high on exposures of the Gordonia Formation Cenozoic regolith. 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 Gordonia Formation exposures within the project area prior to

commencement of the project (as part of a Full Palaeontological Heritage Impact Assessment) 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. The implementation of these protocols should reduce the risk of any negative impacts resulting from the project being minimised to the greatest possible extent. 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.

In summary, this study has not identified any palaeontological reason to prejudice the progression of this project, subject to the recommended 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.

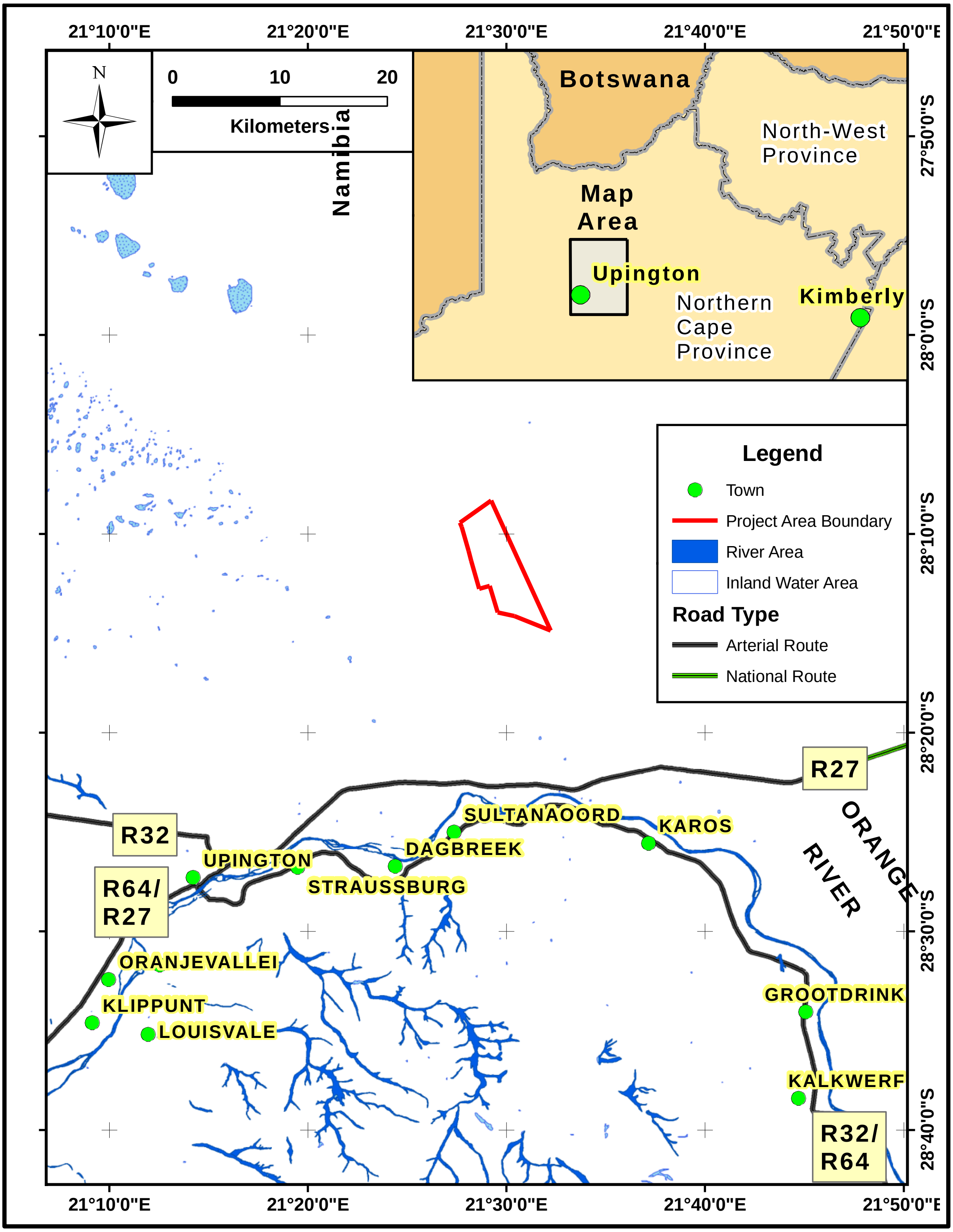

Figure 1: Location map showing the position of the proposed Mercedes-Benz South Africa's vehicle proving ground project area.

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.).

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,
- 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 [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 its 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 disturbance 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

Prof Millsteed holds a PhD in palaeontology and was previously employed by the Council for Geoscience in South Africa as a professional palaeontologist. 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 fair remuneration for these professional services. Neither Prof Millsteed nor BM Geological Services has any financial interest in either Mercedes-Benz South Africa or the proposed vehicle proving ground project.

6 GEOLOGY AND FOSSIL POTENTIAL

Figure 2 shows that the project area appears to be predominantly underlain by bedrock of the Mesoproterozoic Koras Group. There are significant outcrop exposures of the Leerkrans Formation evident close to the southeast margin of the project area and it is possible that the unit will be present beneath the project area; this possibility cannot be confirmed, herein, because almost the entire extent of the project area is covered with sediments of the Kalahari Group. An exposure of the Blauwbosch Granite is located approximately 9.5 km to the south-west of the project area. Intrusive rocks of this granite occur throughout the Koras Group, and may also be present in the project area, being buried beneath the Kalahari Group cover. A summary of the characteristics of these geological units and their fossiliferous potentials follows.

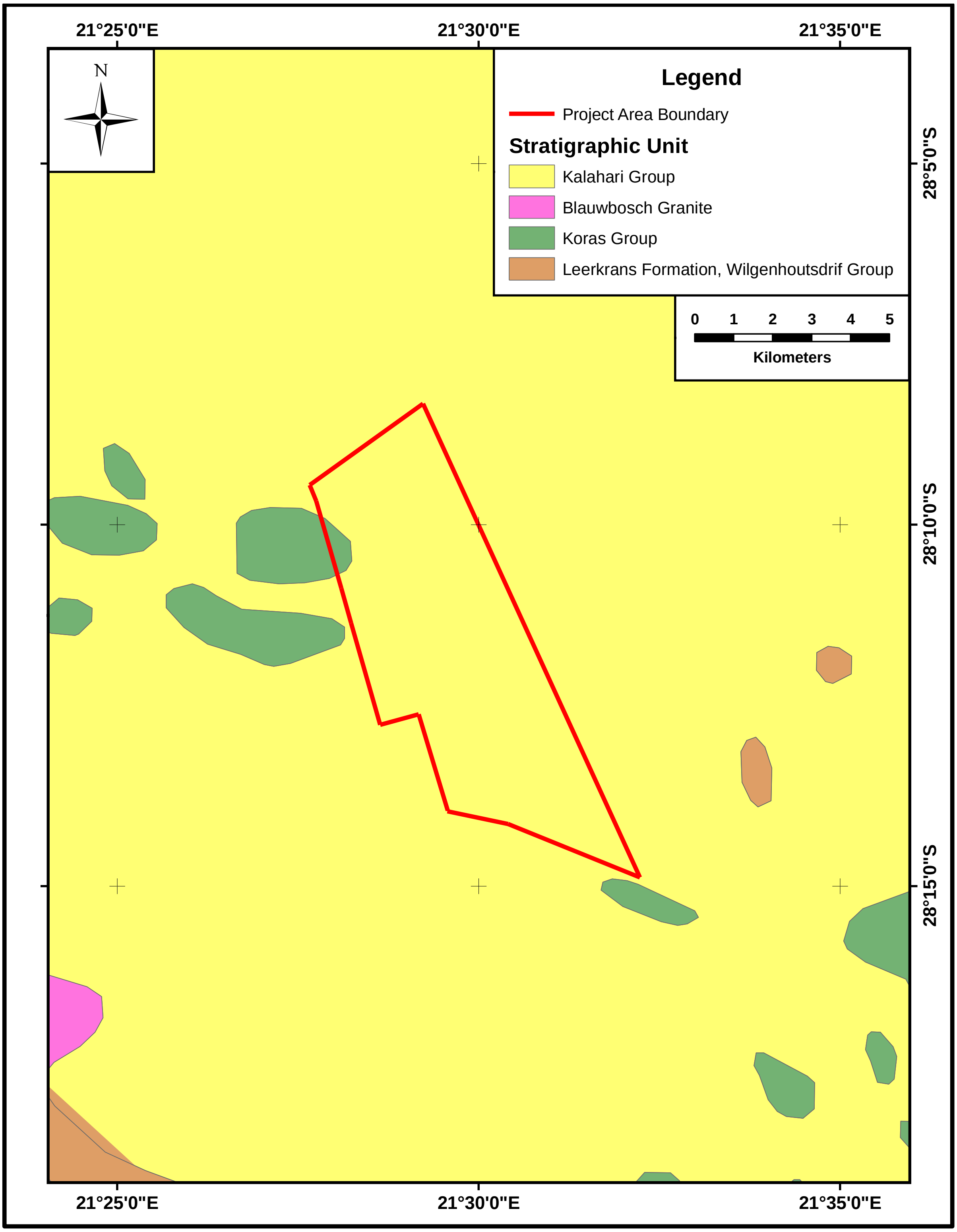

Figure 2: Map of the geology underlying the project area and its surrounding environs.

6.1 Leerkrans Formation, Wilgenhoutsdrif Group

6.1.1 Geology

The Wilgenhoutsdrif Group largely consist of volcanogenic rocks that occupy a wedge-shaped outcrop area and form part of the Palaeoproterozoic to Neoarchaean age Namaqua-Natal Province (Cornell *et al*., 2006). The Leerkrans Formation reveals a cyclic repetition of dominantly volcanic rocks intercalated with sedimentary rocks. The lower cycle consists of a rhyolite overlain by a greenstone unit containing lapilli, calcite-filled amygdales and locally preserved pillow lavas. Metabasic intrusions occur as sill-like bodies within the sequence. A sequence of immature sediments overlie the volcanic rocks and grade upwards from metapelite to schistose quartzite and conglomerate (Cornell *et al*., 2006). The second and overlying cycle commences with a felsic pyroclastic deposit which grades upwards into a tuff. These basal lithologies are overlain by greenstones and pyroclastic rocks which subsequently grade into greenschist and phyllite.

Age dating of the Wilgenhoutsdrif has proved difficult due to pervasive metamorphism caused by the ca. 1100 Ma Namaqua event (Cornell, *et al*., 2006). However, ages of ca 1125 Ma, ca. 1336 Ma and 1331 Ma have been obtained from a lava unit (Barton and Burger, 1983).

6.1.2 Palaeontological potential

Although the sequence is predominantly composed of volcanic strata there are sedimentary rocks present within the sequence. However, the only macrofossil materials known to occur within the Proterozoic-age sediments of South Africa are stromatolite assemblages and these only occur within carbonate successions. Accordingly, the age of the sediments contained within the sequence, their siliciclastic nature and high grade of metamorphism preclude the presence of fossil materials within the stratigraphic unit. Indeed, no fossil materials are known to occur within this unit and it is considered, herein, to be unfossiliferous.

6.2 Koras Group

6.2.1 Geology

The Mesoproterozoic Koras Group is divisible into three sectors; these being the northern, central and southern sectors. The project area is located within the southern sector. The stratigraphic sequence comprising the Koras Group is, in order of decreasing age, the Christiana, Boom River, Swartkopsleegte, Ezelsfontein, Rouxville and Leeuwdraai Formations. Lithologically the sequence consists of interbedded conglomerates, sandstones, volcanic breccia and tuff as well as rhyodacitic, rhyolitic and basaltic lavas (Cornell *et al*., 2006).

The sequence was deposited into a series of grabens and half grabens that formed as a result of the regional scale collision and deformation (approx. 1 200 Ma) that occurred as part of the Namaqua Orogen (Jacobs *et al*., 1993). The strata of the Koras Group are essentially undeformed, but are invariably altered to greenshist facies (Cornell *et al*., 2006). The lower portion of the group has been dated as being 1171 Ma (Gutzmer *et al*., 2000).

6.2.2 Palaeontological potential

The Mesoproterozoic age of the formation indicates that the unit was formed prior to the evolution of life forms capable of producing macrofossils. Stromatolites are common fossil forms in Precambrian carbonate successions throughout South Africa, but the absence of carbonate lithologies within the bedrocks of the area similarly suggest a negligible potential for the preservation of any palaeontological materials. No outcrop of this unit was observed, as it appears to be ubiquitously caped by calcrete and the Gordonia Formation sands.

6.3 Blauwbosch Granite

6.3.1 Geology

The Blauwbosch Granite is the most widespread plutonic rock related to the Koras Group. The unit is an unfoliated, porphyritic alkali granite, which forms relatively small, irregular plutons (Cornwell *et al*., 2006).

6.3.2 Palaeontological potential

The plutonic intrusive nature of the rocks comprising the Blauwbosch Granite precludes any possibility of fossil materials being present within the unit and it is accordingly described as being unfossiliferous.

6.4 Kalahari Group

6.4.1 Geology

The stratigraphic units comprising the Kalahari Group constitute the most extensive body of terrestrial sediments of Cenozoic age in southern Africa. The Kalahari Group is composed (in order of decreasing stratigraphic age) of the Wessels, Budin, Eden, Obobogorob, Gordonia and Lonely Formations (Partridge *et a*l., 2006).

The Late Pliocene/Early Pleistocene to Recent age Gordonia Formation consists of red aeolian sands; the unit is often present as linear sand dune systems. The Gordonia Formation is up to 30 m thick and consists of rounded quartz grains colored red by a thin coating of hematite. Aeolian overprinting of sands originally deposited by streams and sheetwash is evident in some places. A considerable area of the Gordonia Formation is covered by linear dunes which are now stabilized by vegetation. These dunes may have formed as early as the Late Pleistocene or Early Pleistocene (Moore and Dingle, 1998). The Gordonia Formation covers most of the underlying stratigraphic units within the region and usually rests on a calcrete surface. As the present project incorporates plans to mine calcrete in the southern-most portions of the project area (Figure 8) it can be assumed that these calcretes are indeed present in the study area.

6.4.2 Palaeontological potential

The sediments of the Gordonia Formation are not noted for containing either an abundant or diverse palaeontological heritage. Indeed, no fossil occurrences are recorded in the general region in a recent compilation of geological data from the area (Moen, 2007). This paucity of palaeontological materials within the formation is possibly due to two causes. Firstly, the sand dunes that comprise the formation were deposited under dry conditions (Moen, 2007) and active, extensive dune fields are not noted for their abundance of either flora or fauna. Secondly, the unit is composed of unconsolidated, porous sands. The high porosity and permeability of the sands facilitates ready inflow and through-flow of oxidizing meteoric water flowing through these sands is not conducive to the preservation of most biological materials as fossils. Cumulatively there was low potential for biological materials to be incorporated into the sediments and a high probability for the subsequent destruction of any biological materials that may have been contained within the sands by oxidizing ground waters.

The presence of fossils within the sequence in the project area cannot, however, be completely discounted as they are known to be present in similar aged sediments elsewhere in the northwestern portion of South Africa; examples of such fossil occurrences are discussed below.

Occurring commonly within reddish aeolian sands of the Quaternary superficial deposits at Bosluis Pan are spherical calcretised termitarea up to 250 cm across. These termitarea resemble nests constructed by the extant harvester termite *Hodotermes* (Macey *et al*., 2011). There are also smaller nests (8 cm in diameter) resembling those of *Psammatermes* present (De Wit, 1990).

Sediments of Pleistocene and younger age within the Koa River Valley palaeodrainage system at Bosluis Pan and elsewhere in the region contain fragments of egg shells of the modern ostrich as well as shells of the desert snail *Trigonepherus* (Senut and Pickford, 1995; Senut *et al*., 1996).

In the Brandvlei Area (south-east of the project area) and within calcretised basal alluvial facies of the Geelvloer Palaeovalley are bones of anthracotherids (extinct *Hippopotomus*-like artiodactyles) (Macey *et al*., 2011).

Abraded Plio-Pleistocene fossil woods from relict alluvial terraces from the Sak River (just to the north of Brandvlei) includes specimens from the family Polygalaceae (Bamford and De Wit, 1993).

Thick (2 m) shelly coquinas of the small freshwater gastropod *Tomichia ventricosa* occur at elevations up to 10 m above the present day floor of the Swartkolkvloer, approximately 50 km south-west of Brandvlei (Kent and Gribnitz, 1985). These shells have been radiocarbon dated to latest Pliocene (Macey *et al*., 2011). These snails are characteristic of brackish to saline ponds.

7 ENVIRONMENT OF THE PROPOSED PROJECT SITE

The project area, which will contain both phases of the project, is large occupying an area of approximately 3 750 ha. Topographically the area predominantly consists of a flat, featureless land surface (Figures 3-6). The Orange River is located several kilometres to the south of the project area, but no significant drainage lines traverse the project area. A minor road forms the northern boundary to the project area and several dirt tracks traverse the western and southern portions of the project area (Figure 3), but the region is otherwise undeveloped.

Examination of Google earth imagery (Figures 4-6) reveals that indicates that the area is flat and featureless (as indicated above), but is extensively covered by sets of approximately NW-SE oriented linear sand dunes comprised of aeolian sands of the Gordonia Formation. Where the extensive regolith cover is present, no bedrock can be expected to crop out.

Mucina and Rutherford (2006) indicate that the vegetation cover of the entire project area consists of Gordonia Duneveld vegetation type (Figure 7). The conservation status of the veld type is listed as least threatened by Mucina and Rutherford (2006). It appears that the region is probably utilised for grazing and/or game ranching.

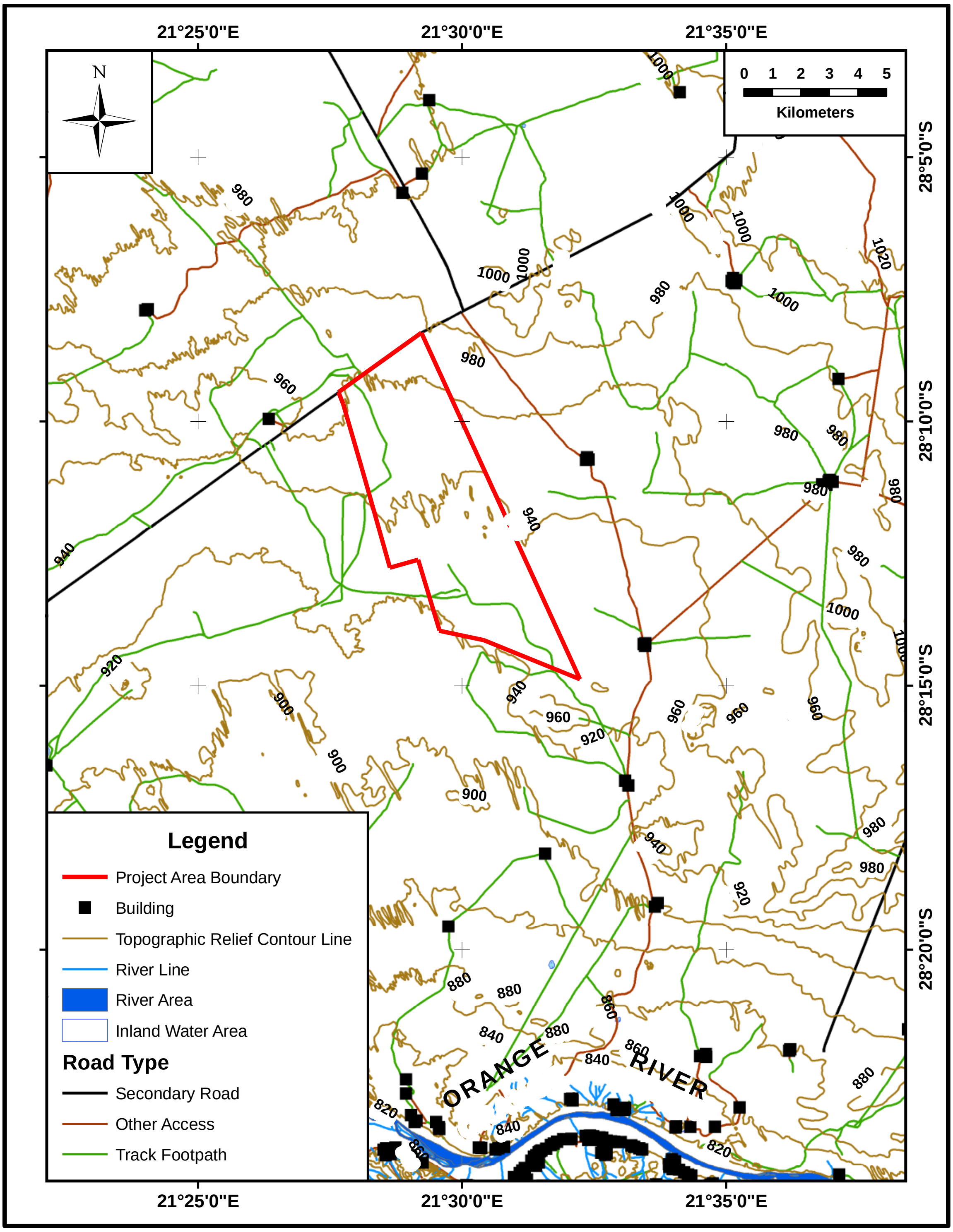

Figure 3: Map of the project area with topographic contours superimposed. It is evident that the project area consists of a flat, featureless landscape. No significant fluvial drainage lines are located within the area, although the Orange River is located several kilometres to the south. The contour interval of the topographic contours is 20 m.

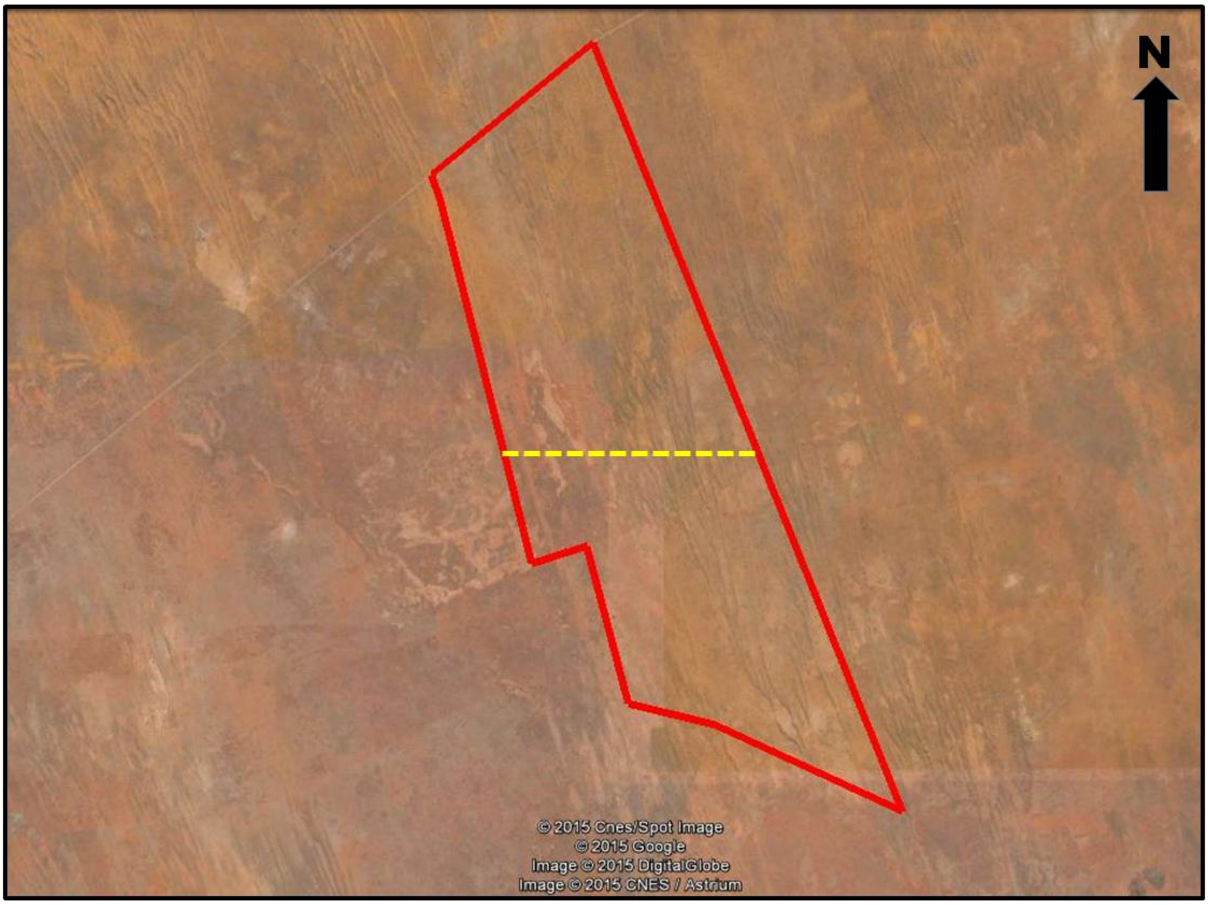

Figure 4: Google Earth image of the project area (the red polygon) and its surrounding environs. Evident from the image is that that the project area and the general environs bear a pervasive and extensive over of Gordonia Formation aeolianites (evident as linear sand dunes). The project area is extremely flat and featureless. The yellow dotted line present near the middle of the project area is in the same position as the yellow, dotted lines that appear the higher magnification images in Figures 5-6.

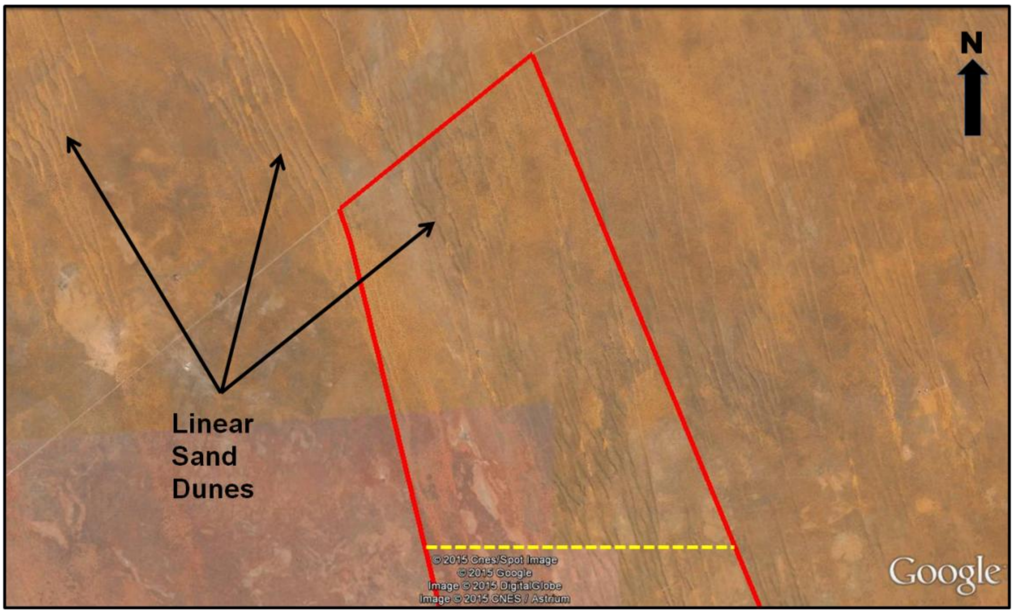

Figure 5: Google earth image of the northern portion of the project area than is presented in the complete view of the project area provided in Figure 4. The extensive cover of Gordonia Formation sand dunes is evident. The yellow, dotted line is in the same position as the similar line in Figure 4.

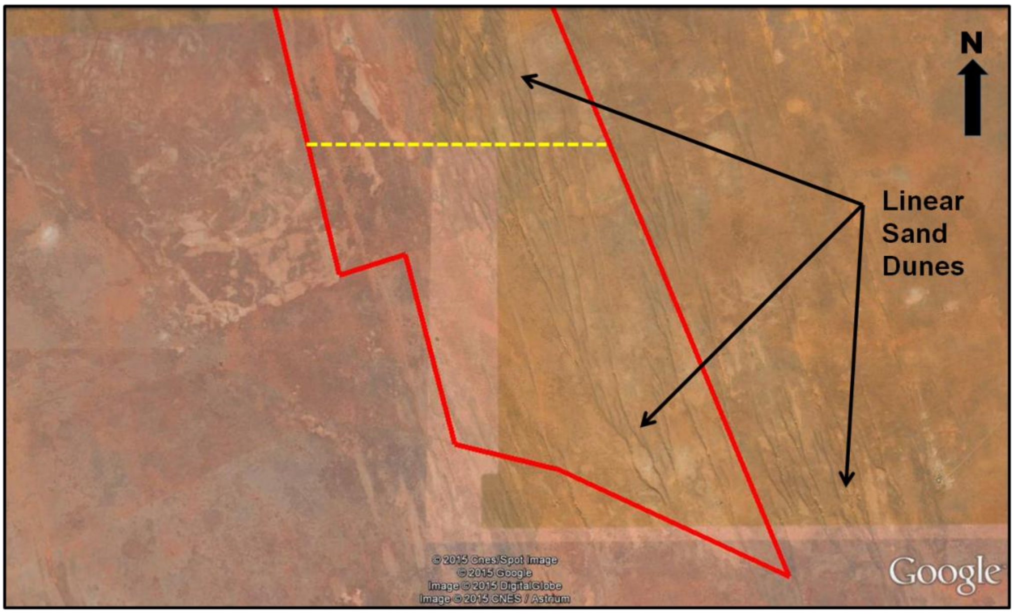

Figure 6: Google earth image of the southern portion of the project area than is presented in the complete view of the project area provided in Figure 4. The extensive cover of Gordonia Formation sand dunes is evident. The yellow, dotted line is in the same position as the similar line in Figure 4.

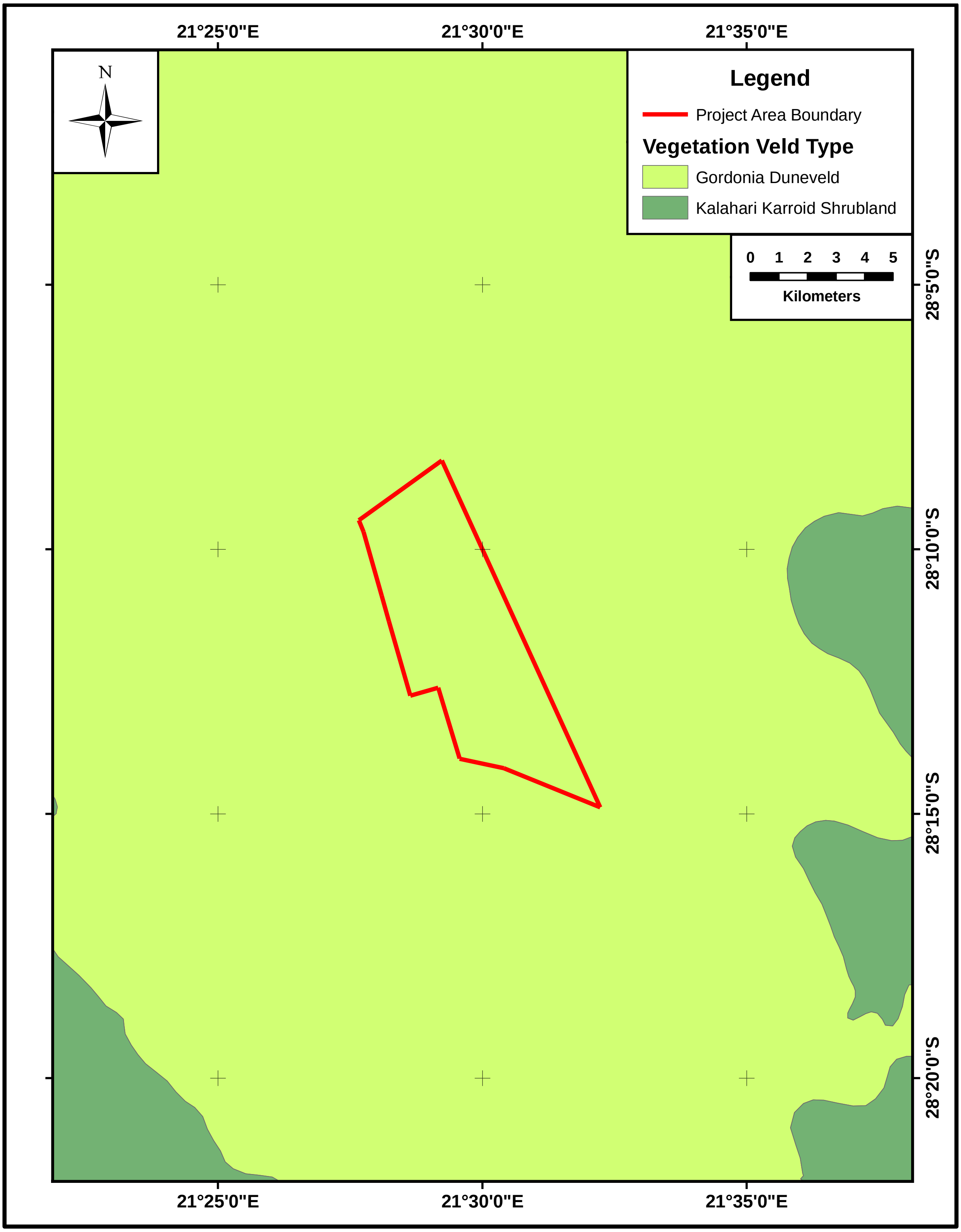

Figure 7: Map of the distribution of the vegetation veld types located within the project area and surrounding environs (after Mucina and Rutherford, 2006).

8 OVERVIEW OF SCOPE OF THE PROJECT

8.1 Project Infrastructure

Following below is a description of the major infrastructure facilities planned on the new proving ground. The distribution of these infrastructure elements within the project area is shown in Figure 8:

- High Speed Oval (length approx. 17 km) incl. 4 lay-by areas, run offs and guard rails,
- Handling Track (length approx. 5,5 km) incl. bypass and run offs (asphalted and gravelled),
- Multifunctional area (size approx. 150x400 m, acceleration lane 25x600 m) and return lanes (width approx. 8m),
- Gravelled Bad Roads (length approx. 10 km),
- Gravelled access roads (length approx. 2 km incl. gravelled parking areas (approx. 2,500 m²),
- Asphalt paved access roads on "confidential side" (length approx. 2,5 km incl. paved parking areas (approx. 3 000 m²),
- Asphalt paved access roads on "public side" (length approx. 2,5 km incl. paved parking areas (approx. 2 000 m²),
- Bridge along access roads crossing the high speed oval,
- Building area according separate plan (buildings, infrastructure, privacy and security fencing, road and civil constructions),
- Guard house at main entrance,
- Security fencing around farm and agricultural fencing on farm,
- Single-lane roads for maintenance and farming purposes along fences (50 km) according usual local standard,

The building area consists of following elements:

- One single-storey workshop-office building, size approx. 40x35 m, including medical centre and dispatcher room,
- Roofed and semi-closed car wash area attached to main building,
- Closed single-storey building for electrical infrastructure,
- Closed single-storey building for water supply incl. base and high reservoir,
- Closed single-storey building for waste storage
- Underground facility for sewerage storage or septic tank,
- One flying roof for 40 cars,
- Combined security/privacy fence around building area,
- Asphalt paved area around buildings (designed for trucks up to 56 000 kg max total gross weight with max axis load acc. National Road Traffic Act 93 of 1996

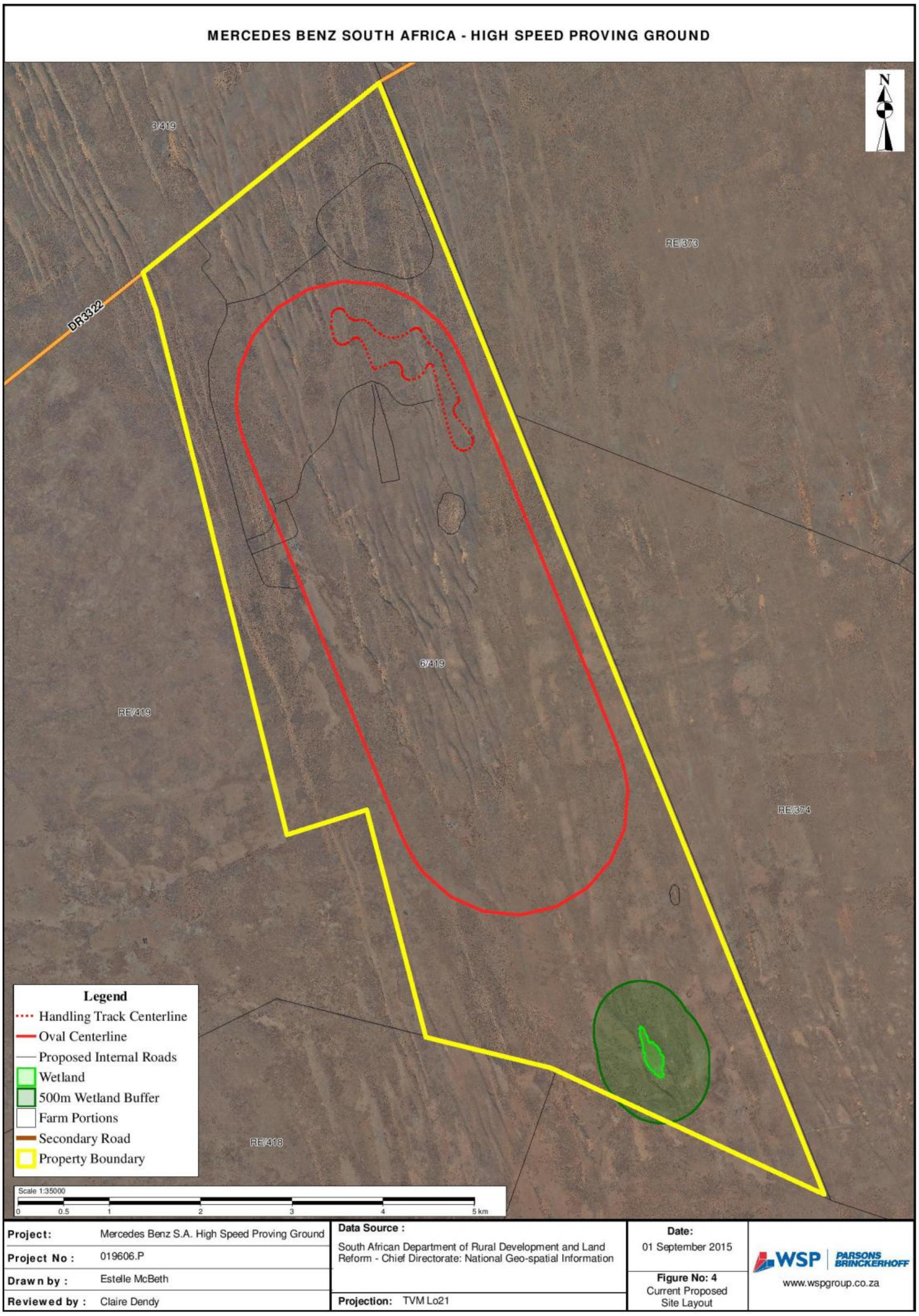

Figure 8: Map of the proposed location of infrastructure elements required for the vehicle proving ground project relative to the boundary of the project area reported upon herein.

- Section 234ff),
- Roofed fuel station,
- Guard House at main entrance to proving ground,
- Distribution cabinet near tower for directional radio,
- Concrete paved areas where necessary due to legislation (e.g. fuelling areas and car wash),

Construction material for road construction is planned to be mined on the property:

- G7-G10 as bulk fill material,
- G3-G5 for base/sub-base,
- Probably G1 for asphalt paving (in dependence of test results),

8.2 Impact of Infrastructure

Construction of the infrastructure will predominantly be limited to the land surface. The underlying geology (and any contained fossils) will be disrupted to a maximum depth of 1-2m over the majority of the area. The deepest disruption expected from the construction of the majority of the infrastructure elements will be due to the construction of building foundations and the installation of underground water and sewerage pipelines.

The excavation of the borrow pit in the southern-most extent of the project area constitutes the potentially deepest and most comprehensive disruption of the geology underlying the project area. The area demarcated for the borrow pit is large (being approx. 98 ha in size) and all rock materials removed will be completely and permanently disrupted and destroyed. However, as the material being mined will be calcrete the excavation would be expected to be several meters deep (i.e., the superficial calcrete deposits and any overlying Gordonia Formation sands) and should not affect the underlying bedrock.

9 IMPACT ASSESSMENT

The potential impact of Mercedes-Benz South Africa's vehicle proving ground facility on the palaeontological heritage of the project area 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 comprising 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 impacts is assessed as potentially **permanent to long term**. This is assessment is based on the fact that, in the absence of mitigation procedures (should undiscovered fossil material be present within the area to be affected) the damage or destruction of any palaeontological materials will be **permanent**. Similarly, any fossil undiscovered materials exist in the subsurface below the structures and infrastructural elements that will constitute the infrastructure elements of the vehicle proving facility will be unavailable for scientific study for the life of the existence of those features (i.e., **long term** > 15 years).

9.4 Probability of Impact

The rocks of the Koras Group, Leerkrans Formation and the Blauwbosch are considered to be unfossiliferous, herein, due to the combination of their Mesoproterozoic age (preceding the advent of macrofossils) and the absence of carbonate lithologies within the sedimentary component of the succession. The granite is a plutonic igneous lithology and, accordingly, cannot be fossiliferous. As such, the probability of the proposed project causing any negative impact on the palaeontological heritage of any of these four units is **nil**.

Calcrete is widespread throughout the region (where it underlies the Gordonia Formation sands). The fact that plans exist to mine calcrete from a borrow pit in the southern extent of the project area signifies their presence within the project area boundary. However, the Kalahari calcretes are considered to be unfossiliferous. As such, the probability of the proposed project causing any negative impact on the palaeontological heritage of any of the calcrete is **nil**.

The sands of the Gordonia Formation are not noted for possessing either an abundant or a diverse palaeontological heritage. However, similarly aged strata within the Northern Cape Province do contain scattered fossil assemblages. However, no fossil material of any description is known to occur within the study area but the possibility remains that there may be fossil material within the Gordonia Formation sands. The probability of any development negatively impacting upon fossil material within the Gordonia Formation is assessed as **low**, but the unit forms the land surface over the majority of the project area and will be directly impacted by the construction of nearly, if not all, infrastructure components.

9.5 Significance of the Impact

The fossils potentially contained within the Gordonia Formation are geologically young and as such, are most significant in terms of information that they may provide concerning insights into the historical climatic and ecological status of the immediate region. Due to the young age of the unit many of the taxa present may be expected to be extant, but a number of extinct taxa are also known to be present within similarly aged sediments elsewhere in South Africa; their significance is potentially **high**. As no fossil materials are expected to be present within the rocks of the Koras Group, Leerkrans Formation or the Blauwbosch Granite the severity of any negative effects on the palaeontological heritage of these rock units is categorised as being **nil**.

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.

9.6 Severity Scale

The probability of a negative impact on the palaeontological heritage of the project area has been categorised as low for the Gordonia Formation (if appropriate mitigation procedures are put into place) and nil for the rocks of the Koras Group, Leerkrans Formation, Blauwbosch Granite and the Kalahari Group calcretes.

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 sediments of the Gordonia Formation may contain important or unique fossils. Thus, it is possible that there are fossils of 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 Africa. Thus, **although the likely hood of any disturbance of palaeontological materials is low, the severity of any impact is potentially 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 procedures are implemented the 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 fossil 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. The project is determined to have 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

It is recommended that thorough examination of the exposures of the Gordonia Formation be made by a palaeontologist prior to the commencement of the project as part of a Full Palaeontological Impact Assessment Study. This would allow a meaningful evaluation of the presence of potentially fossiliferous strata within the project area. If fossil materials prove to be present the process would allow the identification of any such fossils that either should be protected completely or could have damage mitigation procedures emplaced to minimise negative impacts.

It is also recommended that, should the project proceed to commencement, 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 (as required 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 will 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 and total**.

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 highest 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. It must be accepted that fossils occur sporadically within geological units and their location cannot be accurately predetermined.

12 ENVIRONMENTAL IMPACT STATEMENT

A desktop Palaeontological Impact Assessment Study has been conducted on the site of Mercedes-Benz South Africa's proposed vehicle proving ground Facility. The proposed project area is large, being approximately 3 750 ha extent. However, any negative impacts to the palaeontological heritage of the region will be limited to the footprint area of the required infrastructure and the extent of any impacts is accordingly characterised as local.

The effects of the required construction operations upon the geological strata underlying the project area will be restricted to the bedrock strata comprising the Proterozoic Leerkrans Formation, Koras Group and potentially also the Blauwkrans Granite. The Cenozoic Kalahari Group forms an extensive superficial cover sequenced over much of the project area and appears to consist of a layer of calcrete which is immediately overlain by aeolian sand of the Gordonia Formation (the latter often being present as NW-SE oriented sets of linear sand dunes).

The Leerkrans Formation, Koras Group, Blauwkrans Granite and the calcretes of the Kalahari Group are classified as being unfossiliferous herein. Accordingly, both the probability of the project resulting in a negative impact on the palaeontological heritage of these four units assessed as nil, as is the potential significance of any negative impact.

The aeolian sands of the aerially extensive Gordonia Formation are potentially fossiliferous and, as such, there is a potential for negative impact on the palaeontological heritage of this unit over the majority of the project area. However, but the potential risk is categorised as low due to the generally scarcity of fossils in the Gordonia Formation. However, the presence of fossil assemblages has been documented within sediments coeval with the Gordonia Formation elsewhere within the Northern Cape Province and these have provided valuable insights into the palaeoclimate and palaeoecology of the region. Thus, 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. As such, the risk of a negative impact is low, but the significance of any negative impact on the fossil assemblages could potentially be high on exposures of the Cenozoic regolith. 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 Gordonia Formation exposures within the project area prior to commencement of the project (as part of a Full Palaeontological Heritage Impact Assessment) 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. The implementation of these protocols should reduce the risk of any negative impacts resulting from the project being minimised to the greatest possible extent. 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.

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

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