DESKTOP PALAEONTOLOGICAL HERITAGE IMPACT ASSESSEMENT REPORT ON THE SITE OF THE PROPOSED BRONKHORSPRUIT RAIL SIDING REDEVELOPMENT PROJECT, NEAR BRONKHORSTSPRUIT, GAUTENG PROVINCE

16 July 2016

Prepared for:

Heritage Contracts and Archaeological Consulting CC.

On behalf of:

Canyon Resources (Pty) Ltd

Postal address:
P.O. Box 13755
Hatfield
0028
South Africa

Cell: +27 (0) 79 626 9976
Faxs:+27 (0) 86 678 5358
E-mail: bmgeoserv@gmail.com

DESKTOP PALAEONTOLOGICAL HERITAGE IMPACT ASSESSEMENT REPORT ON THE SITE OF THE PROPOSED BRONKHORSPRUIT RAIL SIDING REDEVELOPMENT PROJECT, NEAR BRONKHORSTSPRUIT, GAUTENG PROVINCE

Prepared for:

Heritage Contracts and Archaeological Consulting CC.

On behalf of:

Canyon Resources (Pty) Ltd

Prepared By:

Prof B.D. Millsteed

EXECUTIVE SUMMARY

Canyon Resources (Pty) Ltd proposes to develop and operate a coal loading and transportation facility within the existing Bronkhorstspruit Rail Siding in the Gauteng Province. The proposed facility will be used to receive and dispatch coal from the Khany Colliery, located 6 km east of the siding, for approximately 17 years. The coal product will be transported by means of the existing road network to the proposed coal siding. The existing Bronkhorstspruit Siding lies approximately 1 km to the north of Bronkhorstspruit and is to be located within a portion of Portion 13 and Portions 24, 25, 65 and 66 of the farm Hondsrivier 508 JR, Portion 2 of farm Roodepoort 504 JR, Portion 2 of Farm Schlosberg 505 JR, as well as Portion 1 of farm Carverdale 535 JR, Portion 3 of farm Carverdale 535 JR and Portion 3 of Farm Die Schlosberg 505 JR and Portion 0 of farm Schlosberg 505 JR, Portion 98 of farm Hondsrivier 508 JR, Magisterial District of Bronkhorstspruit, City of Tshwane, Gauteng Province. The aerial extent of the proposed project is approximately 12.2 ha.

Canyon Resources (Pty) Ltd has appointed Zantow Environmental Consulting Services to compile an application for Environmental Authorisation for the development and operation of the coal siding project. Zantow Environmental Consulting Services appointed Heritage Contracts and Archaeological Consulting CC to conduct an Archaeological Impact Assessment for the proposed Bronkhorstspruit Siding redevelopment as part of the Basic Assessment. Heritage Contracts and Archaeological Consulting CC has appointed BM Geological Services to provide a Desktop Palaeontological Heritage Impact Assessment Report in respect of the proposed project area.

The construction of the proposed Bronkhorspruit Rail Siding redevelopment will directly affect the Early Permian glaciogene sediments of the Mbizane Formation (Dwyka Group). Any negative impacts to the palaeontological heritage of the region will be limited to the footprint area of the construction activities and, as such, the extent of any impact is accordingly characterised as local. It is assumed, herein, that the construction of the infrastructure elements that will comprise the project will only impacted upon the upper-most 2 m of the land surface.

Dwyka Group sediments are known to contain rare plant macrofossil assemblages belonging to the *Glossopteris* Flora, equally uncommon arthropod and palynomorph assemblages. Should plant macrofossils of the *Glossopteris* Flora or trace fossil assemblages be present they would be scientifically significant. However, Google earth imagery of the existing Bronkhorstspruit Siding suggests that the majority of the project area has historically been disturbed during the construction of the existing rail siding and that any fossil materials that may have originally been present have been historically damaged or destroyed during the initial construction of the siding. The probability of either of these two macrofossil types being present within the rocks underlying the project area has been assessed as being low. Similarly, palynomorph assemblages

present within the shallow (<2 m) deep surface rocks underlying the project area (and that would therefore be affected by the planned construction) would have already been destroyed by weathering and surface oxidation processes. Accordingly, it is very unlikely that the planned construction activities will result in any negative impact upon the palaeontological heritage of the area. Accordingly, no damage mitigation procedures are required. However, should any fossil materials be identified during the proposed construction activities the mining operations should be halted in that area and SAHRA informed of the discovery (as stipulated by legislation).

This study has not identified any palaeontological reason to prejudice the redevelopment of the Bronkhorstspruit Rail Siding project and no damage mitigation procedures are required.

TABLE OF CONTENTS

TABLE OF FIGURES

1 INTRODUCTION

Canyon Resources (Pty) Ltd proposes to develop and operate a coal loading and transportation facility within the existing Bronkhorstspruit Rail Siding in the Gauteng Province. The proposed facility will be used to receive and dispatch coal from the Khany Colliery, located 6 km east of the siding, for approximately 17 years. The coal product will be transported by means of the existing road network to the proposed coal siding. The existing Bronkhorstspruit Rail Siding lies approximately 1 km to the north of Bronkhorstspruit and is located within a portion of Portion 13, and Portions 24, 25, 65 and 66 of the farm Hondsrivier 508 JR, Portion 2 of farm Roodepoort 504 JR, Portion 2 of Farm Schlosberg 505 JR, as well as Portion 1 of farm Carverdale 535 JR, Portion 3 of farm Carverdale 535 JR and Portion 3 of Farm Die Schlosberg 505 JR and Portion 0 of farm Schlosberg 505 JR, Portion 98 of farm Hondsrivier 508 JR, Magisterial District of Bronkhorstspruit, City of Tshwane, Gauteng Province (Figure 1). The aerial extent of the proposed project is approximately 12.2 ha.

Canyon Resources (Pty) Ltd has appointed Zantow Environmental Consulting Services to compile an application for Environmental Authorisation for the proposed development. Zantow Environmental Consulting Services appointed Heritage Contracts and Archaeological Consulting CC to conduct an Archaeological Impact Assessment for the proposed Bronkhorstspruit Rail Siding redevelopment as part of the Basic Assessment. Heritage Contracts and Archaeological Consulting CC has appointed BM Geological Services to provide a Desktop Palaeontological Heritage Impact Assessment Report in respect of the proposed project area.

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.

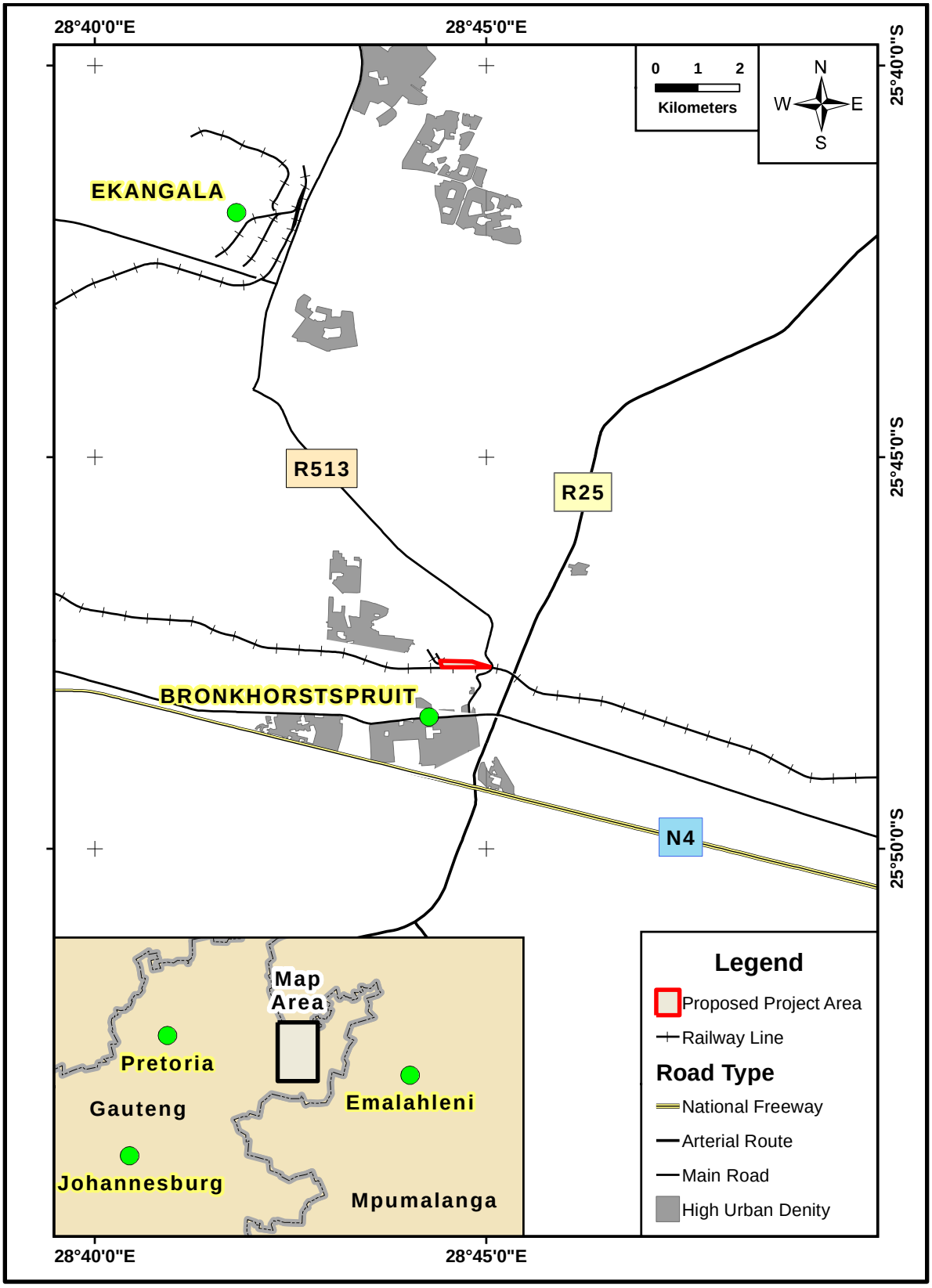

Figure 1: Map showing the location of the proposed Bronkhorstspruit Rail Siding redevelopment project.

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 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

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

5 INDEPENDENCE

Prof Millsteed was appointed to conduct this Palaeontological Heritage Impact Assessment study as an independent consultant and shall receive fair remuneration for these professional services. Neither Prof Millsteed nor BM Geological Services has any financial interest in the proposed rail siding redevelopment project or any associated persons or companies.

6 GEOLOGY AND FOSSIL POTENTIAL

Figure 2 show that the project area is entirely underlain by the Early Permian glaciogene strata of the Dwyka Group, Karoo Supergroup. The project area lies within the coalfields of the Main Karoo Basin (Figure 3) and, as such, the strata comprising the Dwyka Group belong to its northern facies the Mbizane Formation. A summary of the characteristics of the geological units and their fossiliferous potentials follows.

6.1 Karoo Supergroup

6.1.1 Mbizane Formation

6.1.1.1 Geology

The Early Permian Mbizane Formation is characterised by rapid thickness variation and highly variable lithology characterised by a low diamictite (ca. 20%) and a high mudrock (ca. 40%) content (Johnson *et al*., 2006). The Mbizane Formation diamictites are light grey to white coloured due to their high kaolin content. This formation represents deposition by retreating glaciers of lodgement or melt-out deposits within valley and inlet settings (Johnson *et al*., 2006).

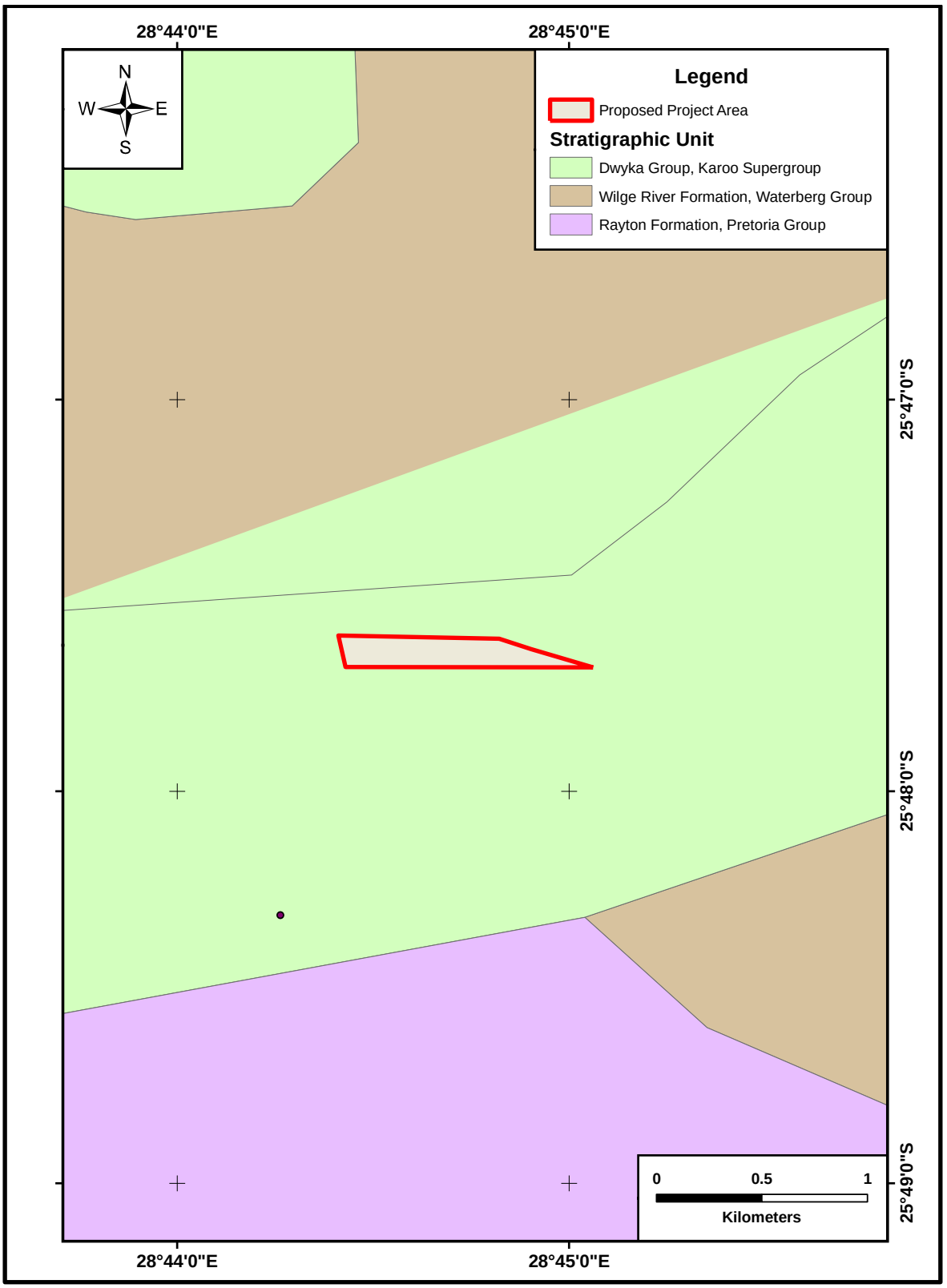

Figure 2: Geological map showing the aerial extent of the geological units that underlie the proposed project infrastructure and surrounding environs.

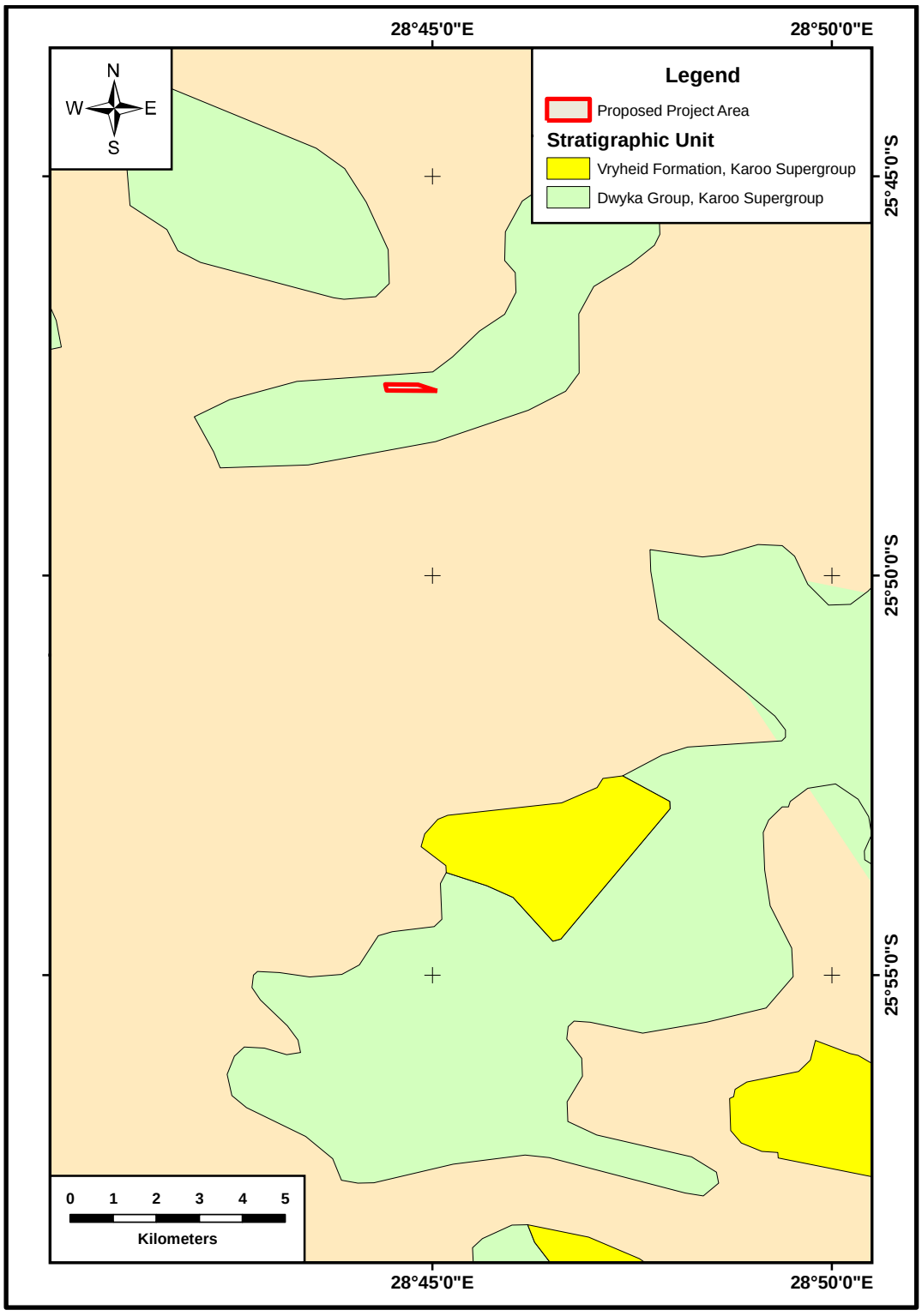

Figure 3: Simplified geological map of the region surrounding the project area (red polygon). The Dwyka Group strata underlying the project and within the general region area lie to the north of, and are associated with, the coal-bearing strata of the Vryheid Formation. The Dwyka Group in this area must accordingly be the terrestrial Mbizane Formation and not the marine facies of the Elandsvlei Formation. All other geological units are grouped together and undifferentiated in the map.

6.1.1.2 Palaeontological potential

The presence of spores and pollens has been noted previously elsewhere within the sediments of the unit by the author as well as other workers. Rare plant remains of (belonging to the *Glossopteris* Flora) and arthropod trackways have also been noted within the unit (Anderson and Mclauchlan, 1976; Bamford (2004).

7 ENVIRONMENT OF THE PROPOSED PROJECT SITE

The site proposed for the redevelopment of the existing Bronkhorstspruit Rail Siding is large measuring approximately 140 m north to south and a maximum east-west length of approximately 1000 m (approximately 12.2 ha in aerial extent).

Examination of Google earth imagery (Figure 4) indicates that the project area lies approximately 1 km to the north of the town of Bronkhorstspruit. A building complex (possibly industrial) is located immediately to the west of the project area and an extensive informal township lies slightly further to the west. At the time of production of the Google earth image a road network existed to the north of the project area and this suggests the building of a further set of built structures in the area. Wetland areas lie immediately proximal to the northern and southern boundaries of the project area and the Bronkhorstspruit River is immediately proximal to the eastern border of the project area (Figure 4). Figure 5 shows that almost the entire extent of the project area's land surface has been disturbed by the construction of the existing rail siding.

Figure 6 indicates that the land surface underlying the entire extent of the project area is flat and featureless. No significant fluvial drainage lines crosscut the project area, but as indicated above (Figures 4 and 6), the Bronkhorstspruit River flows to the south of the project area and lies immediately proximal to its eastern border. Most of the area lying to the east of the project area is utilised for agricultural cultivation. An existing east-west oriented railway line forms the southern margin of the project area and smaller lengths of railways line (forming the existing rail siding) extend in a northwest southeast across the western most extent of the project area.

The entire extent of the project area is vegetated with the Rand Highveld Grassland veld type (Figure 7). Mucina and Rutherford (2006) indicate that the conservation status of the Rand Highveld Grassland veld type is categorised as endangered. It is evident from Figure 5 that little of the original vegetation type appears to remain within the project area. The project area is currently utilised as a railway siding.

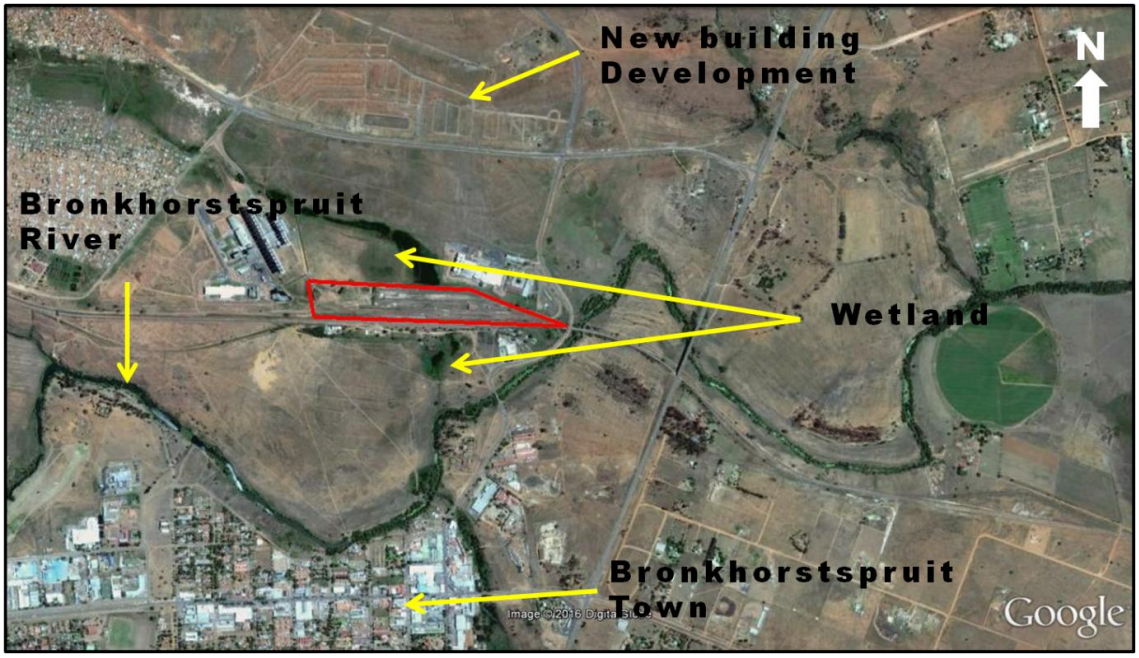

Figure 4: Google earth image of the project area (red polygon) and its surrounding environs. It is evident that the northern and southern margins of the project area are bounded by wetland areas and that the Bronkhorstspruit River lies immediately adjacent to the eastern margin of the area. The town of Bronkhorstspruit lies approximately 1 km to the south, and extensive informal township and building complex lie to the west and it appears that a new building development was under construction north of the project area at the time of the production of the image.

Figure 5: Close-up Google earth image of the project area. It is evident that the majority of the land surface interior of the project area (red polygon) was historically impacted by construction activity (built structures and railway lines).

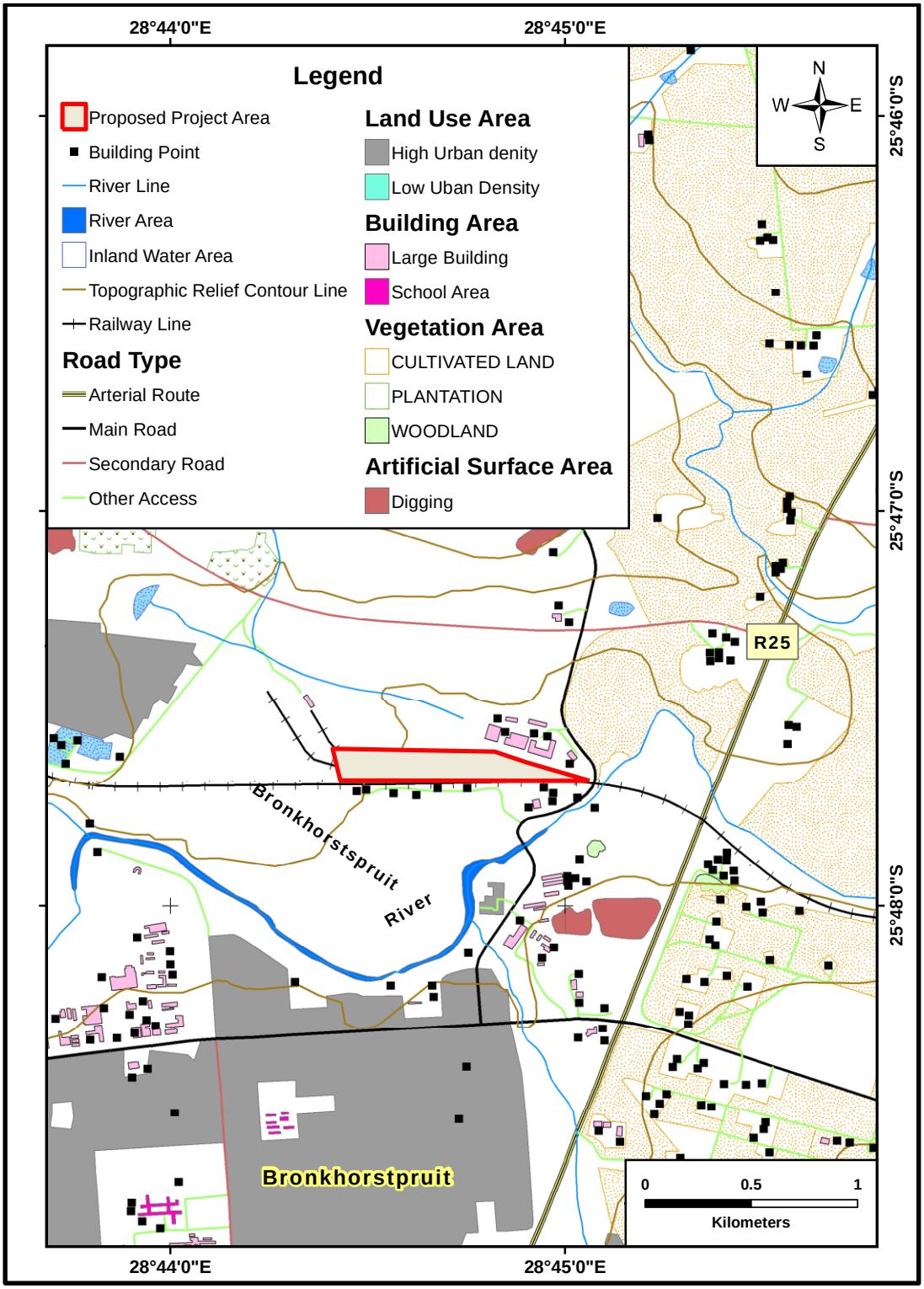

Figure 6: Map of the environment of the project area and its immediate environs. The topographic relief contour interval is 20 m; it is evident that the majority of the region is topographically flat and featureless. No significant fluvial drainage lines traverse the project area, but the Bronkhorstspruit River lies immediately proximal to the eastern margin of the project area.

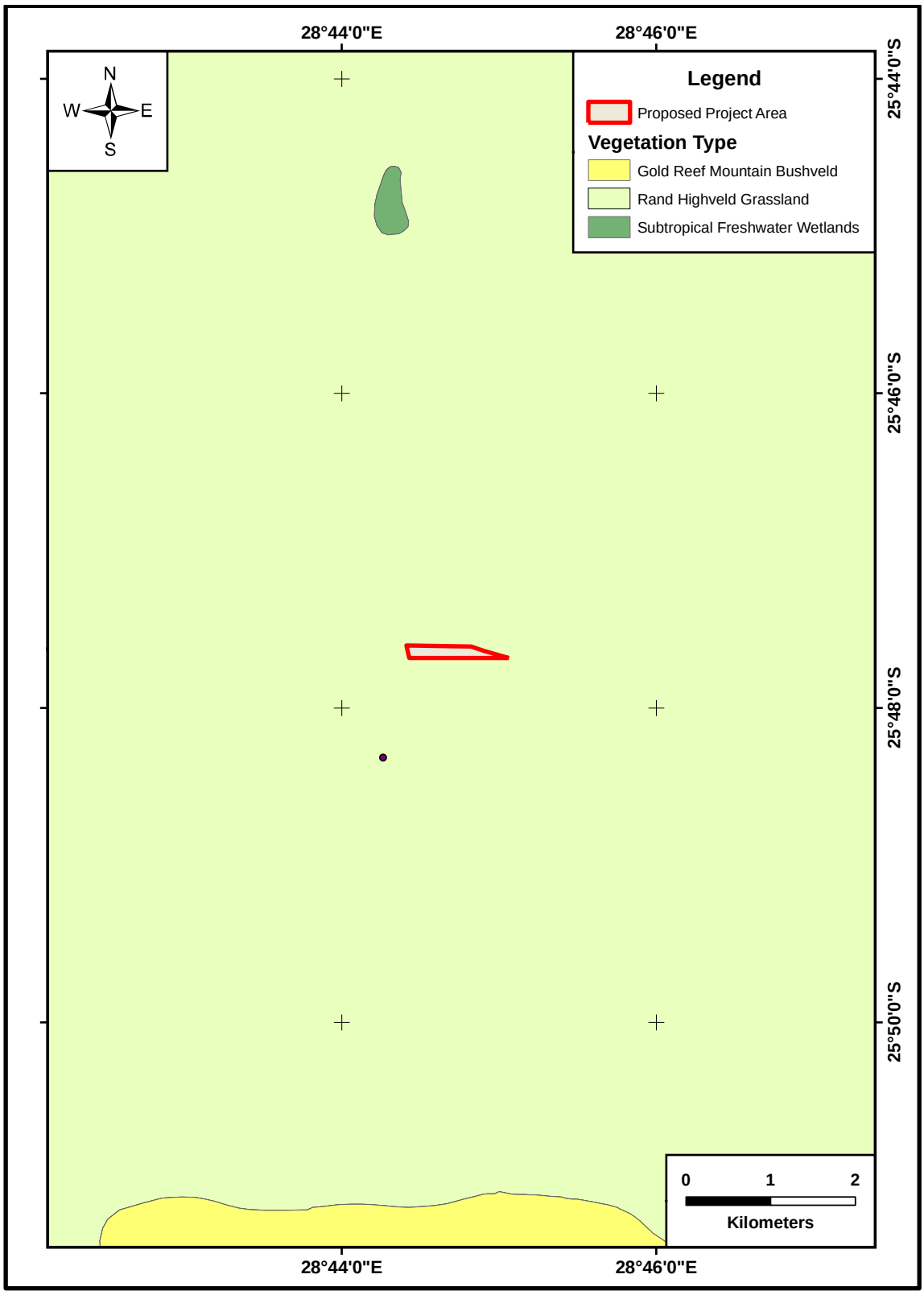

Figure 7: The distribution of the various vegetation veld types occurring beneath the proposed project area and its immediate environs. It is evident that the entire area to be underlain by the project infrastructure (red polygon) consists of the Rand Higveld Grassland veld type (after Mucina and Rutherford, 2006).

8 OVERVIEW OF SCOPE OF THE PROJECT

The proposed redevelopment of the existing Bronkhorstspruit siding will consist of the following activities and infrastructure elements (Figure 8).

8.1 COAL SIDING AND STOCKPILE AREA

Existing tracks will be upgraded to Transnet Freight and Rail (TFR) specifications for the loading of coal product. No additional tracks will be constructed during this process. The coal stockpiling area will be designed to accommodate maximum 12 000 tons of coal product. To prevent any contamination of groundwater, an appropriate liner will be installed across the stockpile area and surface water will be diverted to a pollution control dam (PCD).

8.2 GRAVEL HAUL ROADS

Internal gravel haul road will be constructed for movement of material to and from the coal loading facility.

8.3 POLLUTION CONTROL DAM (PCD)

The PCD will be designed to accommodate a 50 year flood event. Other design specifications are:

- Freeboard of 0.08 m;
- A 2 mm thick high-density polyethylene lining;
- Concrete lined inlets and outlets; and
- A silt trap positioned upstream of the PCD.

8.4 STORMWATER MANAGEMENT SYSTEM FOR THE MANAGEMENT OF CLEAN AND DIRTY WATER AROUND THE COAL STOCKPILES

Stormwater management systems for the management of clean and dirty water around the coal stockpile and siding will be constructed. Surface water from the stockpile will be collected in a concrete lined drains located within the stockpile area. The contaminated water discharged into the lined drains will pass through a silt trap located at the inlet of the PCD.

It has been identified that the existing stormwater infrastructure cannot accommodate a 1:50 year flood event. It is therefore proposed that a cut of trench be constructed upstream of the siding and ensure clean water flows along the northern boundary of the existing mill. It is proposed that the cut-off trench will not alter the current water flows through the siding.

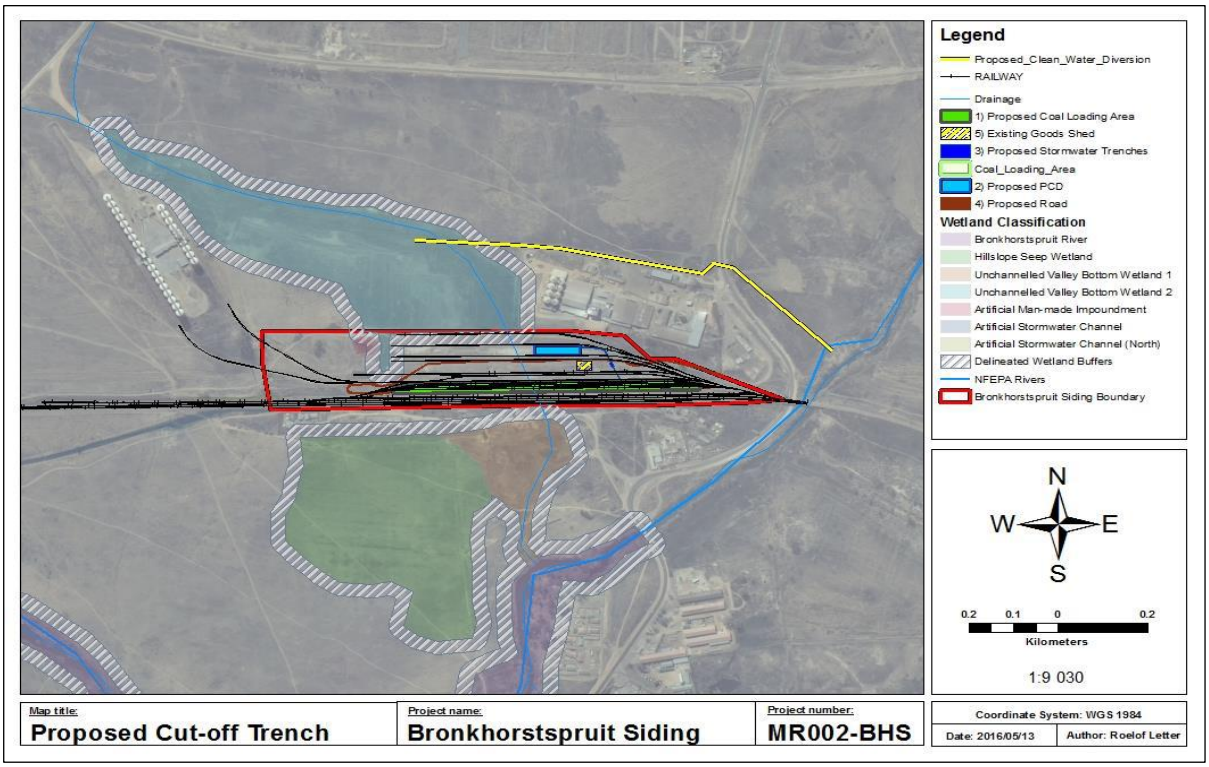

Figure 8: Map showing the location and type of planned infrastructure elements that will comprise the new rail siding project (image supplied by the client).

8.5 RAIL OPERATIONS

TFR Rail Operations were very specific that the following two criteria had to be met after/during construction of the new siding facility.

These were:

- The siding must accommodate a 100 truck train.
- Shunting to and from the TFR Main Line will not be tolerated. The placing of wagons by the TFR locomotives must only incorporate one shunt.

The southern track of the envisaged loading area can accommodate 60 wagons. The northern track can accommodate 50 wagons. The above requirements are thus met.

8.6 ROAD TRAFFIC

The proposed loading area where the coal will be stockpiled is 21 m wide; 6 m of this area is required for Front End Loaders to work in on both the southern and northern side. The area left for stockpiling of coal is therefore 9 m wide. If it is assumed that the

coal will not be stockpiled higher than 2 m. The volume of coal that the loading area can accommodate is less than 12 000 tons.

8.7 Effect upon the bedrock geology

It is evident from Sections 8.1 to 8.6 that the required infrastructure elements are superficial in extent and will only result in the disturbance or destruction of the land surface to a maximum extent of approximately 2 m.

The anticipated life of the project is planned to be 17 years, but the effects of the project upon those rock strata directly impacted will be permanent.

9 IMPACT ASSESSMENT

The potential impact of the proposed mining 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 forming part of the project. The possible source of a less permanent negative impact on the palaeontological heritage is the loss of access for scientific research to any fossil materials that become covered by the various infrastructural elements that comprise the project. The **extent of the area of potential impact is, accordingly, categorised as local** (i.e., restricted to the project site).

9.3 Duration of impact

The anticipated duration of the identified impact is assessed as potentially **permanent to long term**. This is assessment is based on the fact that, in the absence of mitigation procedures (should fossil material be present within the area to be affected) the damage or destruction of any palaeontological materials will be permanent. Similarly, any fossil materials that exist below any new infrastructural elements, but which are not uncovered during the necessary excavations, will be unavailable for scientific study for the life of the existence of those features (i.e., a minimum of 17 years).

9.4 Probability of impact

The rocks of the Mbizane Formation, Dwyka Group, Karoo Supergroup underlie the entire project area. It is known that this unit and its stratigraphic equivalents are fossiliferous elsewhere in South Africa where it contains rare plant macrofossils and uncommon arthropod trackways. As such, there is a low probability of macrofossil materials occurring within the project area. As the majority of the infrastructure to be constructed will probably only impact upon the upper few (2 m) of the land surface relatively little impact on the Mbizane Formation is anticipated. The majority of the Dwyka Group sediments that would be affected by the redevelopment are likely to have already been disturbed during the initial development of the site; any fossil material occurring at, or near, the surface is likely to have been historically damaged or destroyed. The probability of the construction of the new project infrastructure elements causing a negative impact upon the macrofossil heritage of the project area is **low.**

The author's experience shows that the fossil spore and pollen (palynomorphs) content of the Dwyka Group rocks is often abundant. However, the project infrastructure will only affect the upper-most 2 m of the land surface. As such, only the oxidized superficial regolith and upper-most weathered bedrock will be impacted. Palynomorphs are extremely sensitive to oxidation and are usually completely destroyed by surface oxidation processes. As a result of the anticipate oxidation the probability of the construction of the new project infrastructure elements causing a negative impact upon the palynomorph content heritage of the project area's bedrock is **low.**

9.5 Significance of the impact

Should plant macrofossils of the *Glossopteris* Flora be present within the rocks underlying the project area their presence would be scientifically important as they provide a window of understanding into the evolution and composition of the earliest Permian floras of Gondwana. Similarly, any trace fossil materials present would provide very significant data concerning the environments of deposition of the sediments that contain them.

Palynomorph assemblages that may be present within the Dwyka Group sediments are usually biostratigraphically important. However, where palynomorphs occur they are widely distributed within the geological unit. Their destruction within in a restricted portion of an aerially extensive formation will, accordingly, not result in significant loss of palaeontological 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 materials are 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, the probability of a negative impact on the palaeontological heritage contained within the Dwyka Group sediments underlying the project area is categorised as low. However, the significance of any negative impact posed by the project on the plant macrofossil and trace fossil elements of the palaeontological heritage is categorised as potentially high if appropriate mitigation procedures are not put into place.

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

No damage mitigation procedures are required. However, should macrofossil materials be unearthed during the excavations associated with the project the excavations in that area should be halted in that location and SAHRA informed of the discovery (see Section 3.3 above) and a palaeontologist contracted to evaluate their importance. 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 and 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 should be protected and the fossil site excluded from any further construction activities.

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 the conduct of the construction of the project 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, the available scientific literature and the author's knowledge based on previous studies within nearby region. In order to assess the potential impacts of the project upon the palaeontological heritage of the area assumptions were made concerning both the scope of impact that will result from the construction of the identified infrastructure elements. The geological occurrence of fossils within fossiliferous geological units is sporadic and cannot be interpreted with precision or certainty.

12 ENVIRONMENTAL IMPACT STATEMENT

Canyon Resources (Pty) Ltd proposes to develop and operate a coal loading and transportation facility within the existing Bronkhorstspruit Rail Siding. The proposed facility lies approximately 1 km to the north of Bronkhorstspruit and will be located within a portion of Portion 13, and Portions 24, 25, 65 and 66 of the farm Hondsrivier 508 JR, Portion 2 of farm Roodepoort 504 JR, Portion 2 of Farm Schlosberg 505 JR, as well as Portion 1 of farm Carverdale 535 JR, Portion 3 of farm Carverdale 535 JR and Portion 3 of Farm Die Schlosberg 505 JR and Portion 0 of farm Schlosberg 505 JR, Portion 98 of farm Hondsrivier 508 JR, Magisterial District of Bronkhorstspruit, City of Tshwane, Gauteng Province. The aerial extent of the proposed project is approximately 12.2 ha. The life of the project is anticipated to be approximately 17 years.

The construction of the proposed Bronkhorspruit Rail Siding redevelopment will directly affect the Early Permian glaciogene sediments of the Mbizane Formation (Dwyka Group). Any negative impacts to the palaeontological heritage of the region will be limited to the footprint area of the construction activities and, as such, the extent of any impact is accordingly characterised as local. It is also assumed herein, that the construction of the infrastructure elements that will comprise the project will only require the upper-most 2 m of the land surface to be impacted upon.

Should plant macrofossils of the *Glossopteris* Flora or trace fossil assemblages be present they would be scientifically significant. However, Google earth imagery of the existing Bronkhorstspruit Siding suggests that the majority of the project area has historically been subjected to construction activities and that any fossil materials that may have originally been present have been historically damaged or destroyed during the initial construction of the existing rail siding. The probability of either of these two fossil types being present within the rocks underlying the project area is assessed as being low. Similarly, palynomorph assemblages present within the shallow (<2 m) deep rocks underlying the project area (and that would therefore be affected by the planned construction) would have already been destroyed by weathering and surface oxidation processes. Accordingly, it is very unlikely that the planned construction activities will

result in any negative impact upon the palaeontological heritage of the area. Accordingly, no damage mitigation procedures are required. However, should any fossil materials be identified during the proposed construction activities the mining operations should be halted (as per legal requirements set out in Section 3.3 above) in that area and SAHRA informed of the discovery.

This study has not identified any palaeontological reason to prejudice the redevelopment of the Bronkhorstspruit Siding project and no damage mitigation procedures are required.of the Bronkhorstspruit Siding project.

13 REFERENCES

Anderson, A.M. and Mclauchlan, I.R. (1976). The plant record in the Dwyka and Ecca Series (Permian) of the south-western half of the Great Karoo Basin, South Africa. *Palaeontologia Africana*, 19: 31-42.

Bamford, M.K. (2004). Diversity of woody vegetation of Gondwanan southern Africa. *Gondwana Research*, 7: 153-164.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., de V. Wickens, H., Christie, A.D.M., Roberts, D.I., and Brandl, G. (2006). Sedimentary Rocks of the Karoo Supergroup, In Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J. (eds) *The Geology of South Africa*, Johannesburg: Council for Geoscience, Pretoria: Geological Society of South Africa, pp. 461–499.

Mucina, L. and Rutherford, M.C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelizia* 19. South African National Biodiversity Institute, Pretoria.

Republic of South Africa (1998). National Environmental Management Act (No 107 of 1998). Pretoria: The Government Printer.

Republic of South Africa (1999). National Heritage Resources Act (No 25 of 1999). Pretoria: the Government Printer.

Prof B.D. Millsteed

16th July 2016