PALAEONTOLOGICAL IMPACT ASSESSMENT OF THE PROPOSED GALLA HILLS QUARRY ON THE REMAINDER OF THE FARM ROODEKRANTZ 203, IN THE LUKHANJI MUNICIPALITY, DIVISION OF QUEENSTOWN, EASTERN CAPE PROVINCE

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EXECUTIVE SUMMARY

Galla Hills Dairy has applied for a mining permit and environmental authorisation for the operation of an open cast gravel mine (quarry) on an area of 4,9595 ha. The application is for a 2 year period with probable application for extension of 2 x 2 year periods.The borrow pits are proposed for general maintenance in the area.

The proposed development area in Queenstown is underlain by the Early to Middle Triassic Katberg and Burgersdorp Formation (*Lystrosaurus* and *Cynognathus* Assemblage Zone (AZ), Tarkastad Subgroup, Beaufort Group, Karoo Supergroup) as well as Late Cenozoic superficial deposits.

Although the palaeontological sensitivity is rated high, the lack of fossiliferous exposure at the proposed site indicates that the impact on palaeontological material is negligible and regarded as insignificant.

It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required for the commencement of this development, pending the discovery or exposure of any fossil remains during the construction phase.

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1 INTRODUCTION

Galla Hills was previously owned by Mr L. I. van der Vyver who was in the possession of a mining permit for an area of 1.5 ha. Vallon Trust purchased the land from Mr. van der Vyver and thus the mining permit has now expired. Vallon Trust now proposes an open mine quarry with an area of approximately 5 ha in extent (this includes the 1.5 ha of the previous mining permit) (Fig. 1).

Isi-Xwiba Consulting CC has been appointed as the independent Environmental Assessment Practitioner by Galla Hills Dairy for the undertaking of the Basic Environmental Impact Assessment process.

The excavations will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disturb damage or destroy scientific valuable fossil heritage exposed at the surface or buried below ground. Palaeontological material is unique and non-renewable and is protected by the National Heritage Resources Act. A Palaeontological Impact Assessment of the proposed development is therefore necessary to certify that palaeontological material is either removed, or is not present.

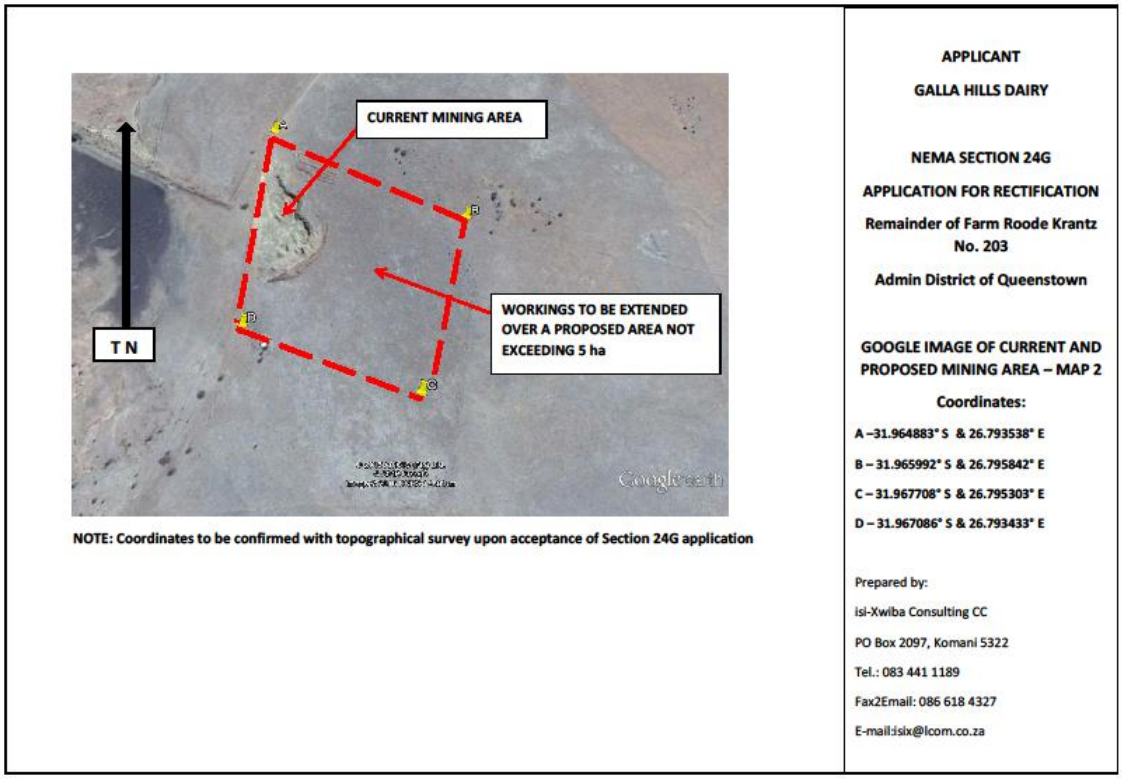

Figure 1. The location of the proposed Galla Hills Quarry on the remainder of the farm RoodeKrantz 203 in the Lukhanji Municipality, Division of Queenstown, Eastern Cape Province. Map provided byIsi-Xwiba Consulting CC.

2 LEGISLATION

Cultural Heritage in South Africa is dealt with by the National Heritage Resources Act (Act 25 of 1999). This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the above mentioned Act. In accordance with Section 38, a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

The **National Heritage Resources Act (Act No. 25 of 1999) (NHRA)** requires that all heritage resources (all places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance) are protected. The Republic of South Africa has a rich fossil record that stretches over a period of approximately 3.5 billion years that have be protected for its scientific value. This unique and non-renewable palaeontological heritage is thus protected in terms of the National Heritage Resources Act. Palaeontological resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act No.25 of 1999):

(i) Objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens.

This report adheres to the guidelines of Section 38 (1) of the National Heritage Resources Act (Act No. 25 of 1999).

Focusingon the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as (a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length; (b) the construction of a bridge or similar structure exceeding 50 m in length; (c) any development or other activity which will change the character of a site—(i) exceeding 5 000 m^2 in extent; or (ii) involving three or more existing erven or subdivisions thereof; or (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority (d) the re-zoning of a site exceeding 10 000 m^2 in extent; (e) or any other category of development provided for in regulations by SAHRA or a PHRA authority.

3 OBJECTIVE

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the aims of the palaeontological impact assessment are:

- to identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.The objective is thus to conduct a desktop study to determine the impact on potential palaeontological material at this site.

When a palaeontological desktop study is conducted, the potentially fossiliferous rocks (i.e. groups, formations, members, etc.) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is collected from published scientific literature; Fossil sensitivity map; consultations with professional colleagues, previous palaeontological impact studies in the same region and the databases of various institutions may be consulted. This data is then used to assess the palaeontological sensitivity of each rock unit of the development area. The likely impact of the proposed development on local fossil heritage is subsequently established on the basis of

- the palaeontological sensitivity of the rocks and
- the nature and scale of the development itself (extent of new bedrock excavated)

When rocks of moderate to high palaeontological sensitivity are present within the development area, a field-based assessment by a professional palaeontologist is necessary. Based on this desktop data as well as a field examination of representative exposures of all major sedimentary rock present, the impact significance of the planned development is considered with recommendations for any further studies or mitigation.

4 BACKGROUND TO THE GEOLOGICAL AND PALAEONTOLOGICALHISTORY

4.1 PALAEONTOLOGY

The Karoo Supergroup strata are between 310 and 182 million years old and span the Upper Carboniferous to Middle Jurassic Periods. During this period the basin developed from an inland sea, flooded by a melting ice cap, to a giant lake (Ecca Lake) fed by seasonal meandering (and periodically braided) rivers. The lake progressively shrank as it filled with sediment and the basin's rate of subsidence stabilised.

The Beaufort group consists of largely fluvial sediments which were deposited on the floodplains of these rivers. In time the land became progressively more arid and was covered with windblown sand just before the end of the basin's cycle. Finally the subcontinent was inundated with basaltic lava to form the capping basalts of the Jurassic aged Drakensberg Group.During the Jurassic the volcanic Drakensberg were formed and cracks in the earth's crust were filled with molten lava that cooled to form dolerite dykes. Magma injected horizontally between sediments, cooled down and formed horizontal stills of dolerite.

The flood plains of the Beaufort Group (Karoo Supergroup) are internationally renowned for the early diversification of land vertebrates and provide the worlds' most complete transition from early "reptiles" to mammals (therapsids).

The Beaufort Group is subdivided into a series of biostratigraphic units on the basis of its faunal content (Fig. 2). The proposed development area in Queenstown (Fig. 3) is underlain by the Early to Middle Triassic Katberg and Burgersdorp Formations (*Lystrosaurus* and *Cynognathus* AZ, Tarkastad Subgroup, Beaufort Group, Karoo Supergroup). Late Caenozoic superficial sediments are also present in the development area.

The *Lystrosaurus* AZ also includes the Palingkloof Member (*Daptocephalus* AZ, Adelaide Subgroup) (Groenewald and Kitching 1995, Rubidge 2005). The lower Palingkloof Member is palaeontologically important as it precedes the Permo-Triassic Extinction Event which is the contender for the greatest Mass Extinction in history. This extinction almost destroyed the vertebrate fauna and killed off the diverse glossopterid plants. The fossil heritage of the Early Triassic Katberg Formation is thus also palaeontological significant because they document the recovery of terrestrial biotas succeeding the catastrophic end-Permian Mass Extinction event (approximately 251 million years ago).

The *Lystrosaurus* AZ (Katberg Formation) is named after the dicynodont *Lystrosaurus* which contributes up to 95% of fossils found in this biozone (Botha & Smith 2007). The *Lystrosaurus* AZ is also known for the small captorhinid parareptiles *Procolophon* and a crocodile-like early archosaur, *Proterosuchus*. Armour-plated "labyrinthodont" amphibians (e.g. *Lydekkerina*) are also present in this biozone as well as small true reptile owenettids, therocephalians, and early cynodonts (*e.g. Galesaurus, Thrinaxodon*). This biozone is also characterized by vertebrate and invertebrate burrows. Invertebrate burrows are represented by aquatic and land living organisms while tetrapod burrows include various cynodonts, procolophonids and *Lystrosaurus* (Groenewald 1991, Groenewald and Kitching, 1995, Damiani *et al.* 2003, Abdala *et al.* 2006). Vascular plants in this biozone are generally rare but petrified wood ("*Dadoxylon*") and leaves of glossopterid progymnosperms and arthrophyte ferns (*Schizoneura*, *Phyllotheca*) are present.

The *Cynognathus* AZ (Burgersdorp Formation is approximately 249 to 237 milllion years old [(Kitching 1995, Rubidge 2005]) is dominated by amphibians, reptiles and therapsids. The Burgersdorp biotas include rich freshwater vertebrate fauna, fish groups as well as large capitosaurid and trematosuchid amphibians. The reptile fauna includes lizard-like sphenodontids, rhynchosaurs, and primitive archosaurs. Therapsids include *Kannemeyeria and* numerous small to medium-sized carnivorous and herbivorous therocephalians and advanced cynodonts. Tetrapod trackways and burrows are also present.

Late Cenozoic sediments consist mostly of superficial deposits (Partridge, 2005). The Quaternary represents a time span of approximately 2.5 million years ago to present (Walker *et. al*., 2009; Gradstein *et al*., 2012). These alluvium sediments may also contain fossil remains which might include rolled bones, intact or fragmented vertebrate skeletons, vertebrate teeth, invertebrates such as molluscs and crustaceans, trace fossils of fossilised termite heaps (termitaria) and burrows of both vertebrates and invertebrates. Furthermore, fossilised plant remains such as wood and roots might also be present in these sediments. All the above mentioned fossils however, tend to be low in variety as well as in abundance in these cover soil which obscure the underlying bedrock.

4.2 GEOLOGY

The Early Triassic Tarkastad Subgroup is characterised by a greater relative abundance of sandstone and red mudstone than in the Adelaide Subgroup. In the Queenstown area the Katberg Formation is sandstone-rich, while the Burgersdorp Formation is mudstone-rich. Sandstones in the Katberg Formation are fine to medium grained. Oval to spherical calcretions is relatively common. The Burgersdorp Formation sandstones are fine grained greenish grey or light brownish grey with horizontal lamination. In both formations intraformational mud-pellet conglomerates are common. Red colours dominate in the mudstones of both formations.

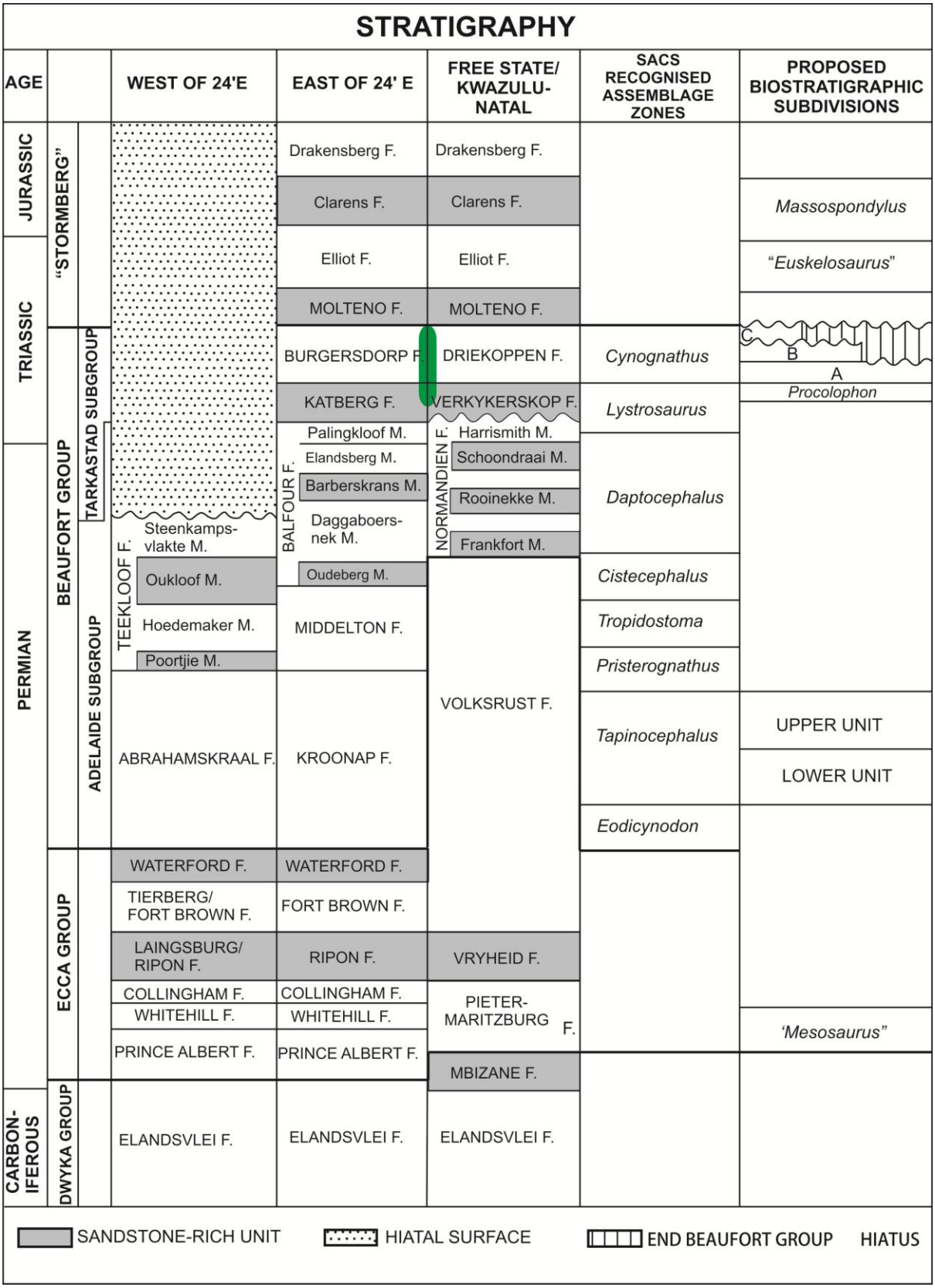

Figure 2: Karoo stratigraphy and biostratigraphy (after Smith *et al*., 2012). Green line indicates the stratigraphic interval impacted by the proposed development.

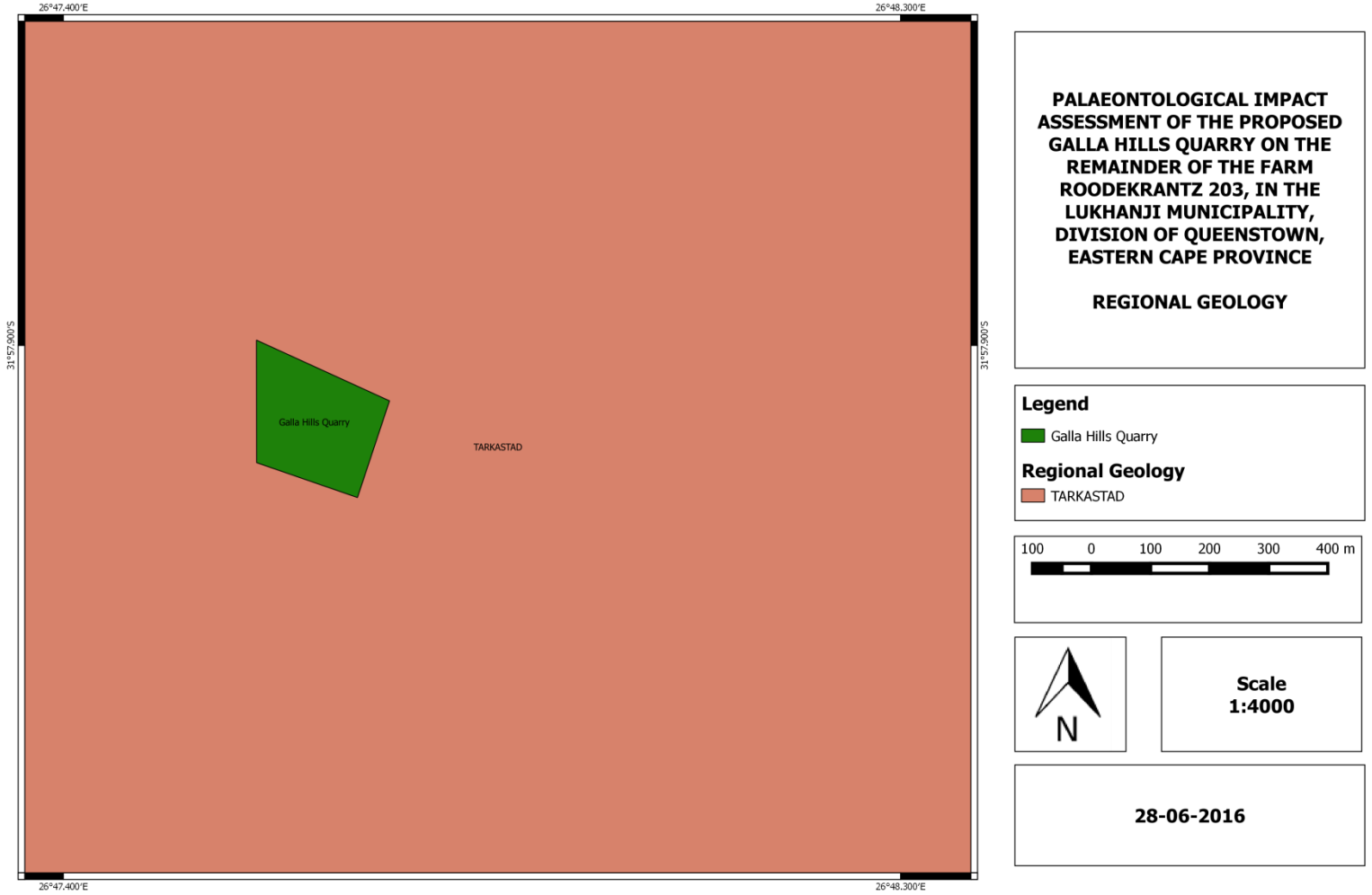

Figure 3. The surface geology of the Queenstown development area the remainder of the farm RoodeKrantz.203 in the Lukhanji Municipality, Division of Queenstown, Eastern Cape Province. The development area is underlain by Early to Middle Triassic Katberg and Burgersdorp Formation (Tarkastad Subgroup, Beaufort Group, Karoo Supergroup).

5 GEOGRAPHICAL LOCATION OF THE SITE

Location: 31º 57’ 57.50” S and 26º 47’ 37.75” E

The proposed development area of the Galla Hills quarry is located on the remainder of the farm RoodeKrantz. 203 in the Lukhanji Municipality, Division of Queenstown, Eastern Cape Province.

6 METHODS

A Palaeontological Impact Assessment was conducted to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed areas of development. The author’s experience, aerial photos (using Google, 2015), topographical and geological maps and other reports from the same were used to assess the proposed area of development.

6.1 ASSUMPTIONS AND LIMITATIONS

The accuracy and reliability of desktop Palaeontological Impact Assessments as components of heritage impactassessments are normally limited by the following restrictions:

- Old fossil databases that have not been kept up-to-date or are not computerized. These databases do not always include relevant locality or geological information. South Africa has a limited number of professional palaeontologists that carry out fieldwork and most development study areas have never been surveyed by a palaeontologist
- The accuracy of geological maps where information may be based solely on aerial photographs and small areas of significant geology have been ignored. The sheet explanations for geological maps are inadequate and little to no attention is paid to palaeontological material.
- Impact studies and other reports (*e.g*. of commercial mining companies) - is not readilyavailable for desktop studies.

Large areas of South Africa have not been studied palaeontologically.Fossil data collected from different areas but in similar Assemblage Zones might however provide insight on

possible occurrence of fossils in an unexplored area. Desktop studiesof this nature thereforeusually assumethe presence of unexposed fossil heritage within study areas of similar geological formations. Where considerable exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly improved through field assessment by a professional palaeontologist.

7 Site Visit

Figure 4. Cenozoic alluvium covered landscape of the development area

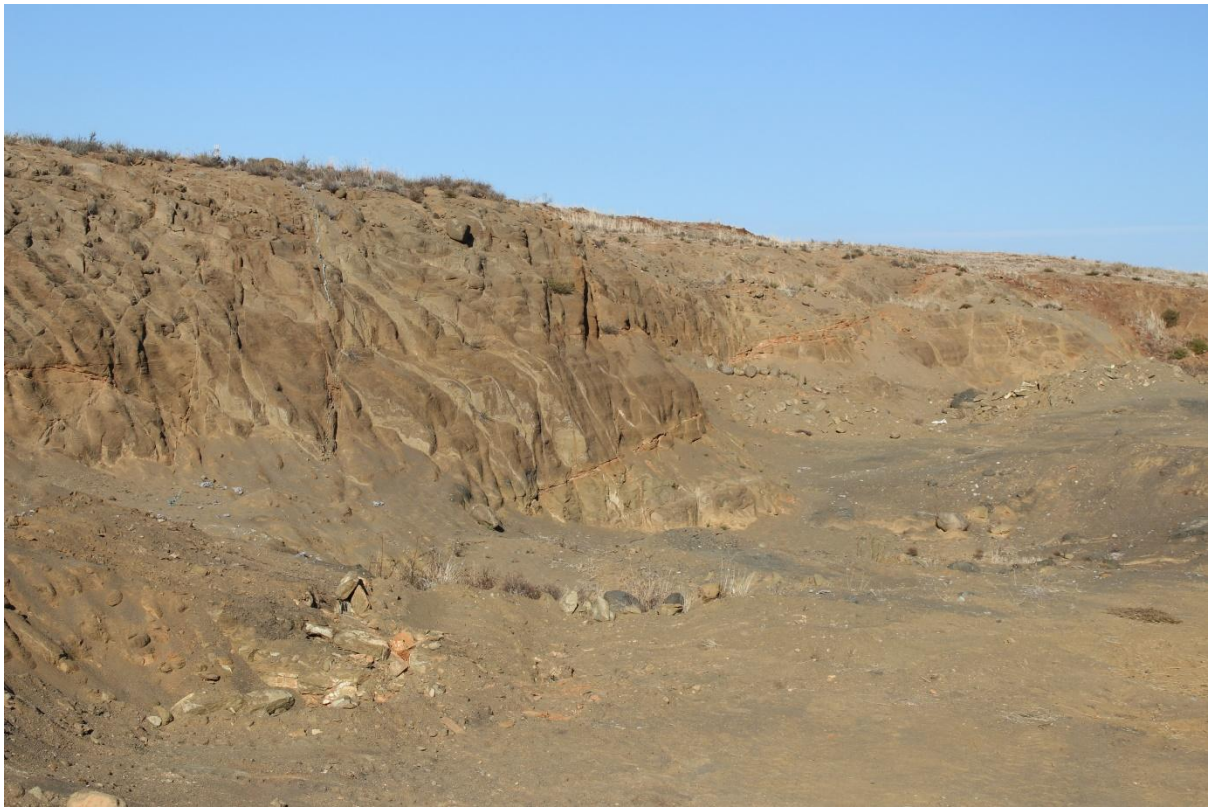

Figure5. Existing gravel quarry

8 FINDINGS AND RECOMMENDATIONS

The borrow pit was investigated, and no palaeontological resources were observed. The absence of potentially fossiliferous exposures on the development site in Queenstown suggest that fossils are absent from this site. The impact on paleontological material is thus negligible and regarded as insignificant**.** It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation arerequired for the commencement of this development, pending the discovery or exposure of any fossil remains during the construction phase.

Should fossil remains be discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO responsible for these developments should be alerted. Such discoveries ought to be protected (preferably *in situ*) and the ECO should alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (*e.g.* recording, sampling or collection) can be taken by a professional paleontologist.

The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved collection (*e.g.* museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

9 REFERENCES

ABDALA, F., CISNEROS, J.C., and SMITH, R.M.H. 2006. Faunal aggregation in the Early Triassic Karoo Basin: earliest evidence of shelter-sharing behaviour among tetrapods. Palaios 21, 507-512.

BOTHA, J., and SMITH, R.M.H. 2007.*Lystrosaurus* species composition across the Permo-Triassic boundary in the Karoo Basin of South Africa. Lethaia 40, 125-137).

DAMIANI, R., MODESTO, S., YATES, A. & NEVELING, J. 2003.Earliest evidence for cynodont burrowing. Proceedings of the Royal Society of London B. 270, 1747-1751.

GRADSTEIN, F.M., J.G.OGG, M.D. SCHMITZ & G.M.OGG.(Coordinators). 2012. The Geologic Time Scale 2012. Boston, USA: Elsevier, 2 volumes plus chart, 1176 pp.

GROENEWALD, G.H. & KITCHING, J.W. 1995.Biostratigraphy of the *Lystrosaurus* Assemblage Zone.Pp. 35-39 in RUBIDGE, B.S. (ed.) Biostratigraphy of the Beaufort Group (Karoo Supergroup).South African Committee for Stratigraphy, Biostratigraphic Series No. 1, 46 pp. Council for Geoscience, Pretoria.

GROENEWALD, G.H. 1991. Burrow casts from the *Lystrosaurus-Procolophon* Assemblage-zone, Karoo Sequence, South Africa. Koedoe 34, 13-22.

GROENEWALD, G.H. 1996. Stratigraphy of the Tarkastad Subgroup, Karoo Supergroup, South Africa.Unpublished PhD thesis, University of Port Elizabeth, South Africa.

JOHNSON, M.R., VAN VUUREN, C.J., VISSER, J.N.J., COLE, D.I., WICKENS, H. DE V., CHRISTIE, A.D.M., ROBERTS, D.L. & BRANDL, G. 2006. Sedimentary rocks of the Karoo Supergroup. Pp. 461-499 *in* Johnson. M.R., Anhaeusser, C.R. & Thomas, R.J. (eds.) The geology of South Africa. Geological Society of South Africa, Johannesburg & the Council for Geoscience, Pretoria.

MCCARTHY, T. & RUBIDGE, B. 2005. The story of Earth and life: a southern African perspective on a 4.6-billion-year journey. 334pp. Struik, Cape Town.

Smith, R., Rubidge, B. and van der Walt, M. 2012. Therapsid Biodiversity Patterns and Palaeoenvironments of the Karoo basin, south Africa in edChinsamyTuran, A. *Forerunnersof Mammals*. IndianaUniversity Press.

RUBIDGE, B.S. (Ed.) 1995. Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Biostratigraphy, Biostratigraphic Series No. 1., 46 pp. Council for Geoscience, Pretoria.

RUBIDGE, B.S. 2005. Re-uniting lost continents – fossil reptiles from the ancient Karoo and their wanderlust. 27th Du Toit Memorial Lecture. South African Journal of Geology 108, 135-172.

SMITH, R. & BOTHA, J. 2005.The recovery of terrestrial vertebrate diversity in the South African Karoo Basin after the end-Permian extinction.ComptesRendusPalevol 4, 555-568.

WALKER, J.D. & J.W. GEISSMAN. 2009. Geologic Time Scale. Geological Society of America.