PALAEONTOLOGICAL IMPACT ASSESSMENT REPORT FOR A MANGANESE MINE

Farms Kipling 271, Hotazel 280, Devon 277 and Perth 276, near Hotazel Town in the John Toalo Gaetsewe District Municipality in the Northern Cape Province

Developer: **KUDUMANE MANGANESE RESOURCES (PTY) LTD**

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By:

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EXECUTIVE SUMMARY

This report forms part of the Environmental Impact Assessment Report for the Kudumane Manganese Mining Project. This report complies with the requirements for a Phase 1 Palaeontological Impact Report as required from SAHRA (Environmental Impact Assessments required in terms of the National Environmental Management Act, Act 107 of 1998, or of the Environment Conservation Act, Act 73 of 1989 and Heritage Impact Assessments called for in terms of Section 38 of the National Heritage Resources Act, Act No. 25, 1999 by a heritage resources authority).

Kudumane Manganese Resources (Pty) Ltd is developing a new manganese mine near Hotazel town in the John Taolo Gaetsewe District Municipality in the Northern Cape Province. In broad terms the project will include the establishment of an opencast and future underground mining operation, associated residue handling and disposal facilities, a crushing and screening plant, water management facilities, rail and road transport infrastructure and various support infrastructure and services. The project is taking place on the farms York A 279 and Telele 312. The present Mining Right Application refers to a proposed extension of the mining operations on the farms Kipling 271, Hotazel 280, and Devon 277, excluding the farm Perth 276. Information for the farm Perth 276 is however, also included in this report as these surveys were completed as part of the Palaeontological Impact Assessment for all the farms since 2011.

The proposed mining site is underlain by claystone, calcrete and dune sand of the Cretaceous to Tertiary Kalahari Formation, which is in turn underlain by remnants of the Dwyka tillite of the Karoo Supergroup and Proterozoic aged Hotazel Iron Formation and underlying Ongeluk lava Formation.

The Cretaceous to Tertiary Kalahari Formation overlies the entire study area and outcrops of the more resistant limestone are restricted to the banks of the GaMogara River. No conclusive evidence of fossils was found in either of the red claystone, conglomeratic limestone, calcareous sandstone or sand dunes of this formation and only two “pseudo-bone” remains have been recorded after two days of field investigations during 2011. Field work during 2013 did not reveal any fossils on the farms Kipling 271, Hotazel 280, Devon 277 and Perth 276.

It is recommended that the Environmental Control Officer be informed of the possibility of pseudo-bone fragments in the limestone and that it will be necessary to note any structure that might indicate bone material to a qualified Palaeontologist, who must then inform SAHRA of such a find. If such a find is recorded it will be necessary to research and compile a Phase II palaeontological report during the excavation of the open cast mine.

The Proterozoic aged Hotazel Formation contains micro-stromatolite structures and due to a lack of outcrops in the area that will be mined, these are only visible in borehole core samples. The Environmental Control Officer must be aware of these structures and report the presence of stromatolites to the Mine Management and to SAHRA.

It is recommended that, if recorded during open cast mining operations, a representative sample of at least $1m^3$ be collected before a permit is issued for the destruction of the stromatolites during future mining activities. Due to the very specific targeting of Manganese ore bodies during future underground mining activities, the impact on stromalite structures will be negligible.

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1. INTRODUCTION

This report forms part of the Environmental Impact Assessment Report for the Kudumane Manganese Mining Project. This report complies with the requirements for a Phase 1 Palaeontological Impact Report as required from SAHRA (Environmental Impact Assessments required in terms of the National Environmental Management Act, Act 107 of 1998, or of the Environment Conservation Act, Act 73 of 1989 and Heritage Impact Assessments called for in terms of Section 38 of the National Heritage Resources Act, Act No. 25, 1999 by a heritage resources authority).

A request for a Phase 1 Palaeontological Assessment report was received from SLR Consulting during July 2014. Following the "*SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports*" the following Terms of Reference applies: i) Desk top investigation, ii) Site visit and verification of desk top information and iii) To complete a Phase 1 Palaeontological Impact Report

This report follows on a similar reports provided during 2011 and 2013. Where applicable, information of the two reports will complement each other.

2. PROJECT DESCRIPTION

Kudumane Manganese Resources (Pty) Ltd. is developing a new manganese mine near Hotazel town in the John Taolo Gaetsewe District Municipality in the Northern Cape Province (Figure 2.1). In broad terms the project will include the establishment of an opencast and future underground mining operation, associated residue handling and disposal facilities, a crushing and screening plant, water management facilities, rail and road transport infrastructure and various support infrastructure and services. The project is taking place on the farms York A 279, and Telele 312 (Figure 2.1). Although the present Mining Right Application refers to a proposed extension of the mining operations to the farms Kipling 271, Hotazel 280, and Devon 277, information for the farm Perth 276 is also included as these surveys were completed as part of the Palaeontological Impact Assessment for all these farms. The aspects of the mine and proposed project are outlined in Table 2.1.

Table 2.1 Aspects and Detail of the Kudumane Manganese Project

Aspect	**Detail**
Province & Magisterial district	Northern Cape - John Taolo Gaetsewe
Local district	John Taolo Gaetsewe District Municipality Management Area
Municipal ward	John Taolo Gaetsewe District Municipality Management Area Ms M. Shuping
Farms on which the project will be located	York A 279, Devon 277 and Telele 312, Kipling 271, Hotazel 280, and Perth 277
Nearest residential areas	Hotazel (±3km to the north-east), Kuruman (±50km south east) and Kathu (±50km south)
Catchment and water management area	Orange River Basin – Quaternary catchment D41K
Presence of servitudes	Rail, R380, R31, D3336, Power lines and Telkom lines
Topographic landmarks	The project site is situated within a flat area located close to the GaMogara River.
Co-ordinates of project area	25º 41' 25.22" South and 27º 43' 47.51" East
Geological Setting	Proterozoic Hotazel Iron Formation, Voelwater Subgroup, Transvaal Supergroup, Overlying Cretaceous to Tertiary Kalahari Formation
Palaeontology	Stromatolites and algal structures in Proterozoic dolomites and possible vertebrate remains in Cretaceous and Tertiary deposits

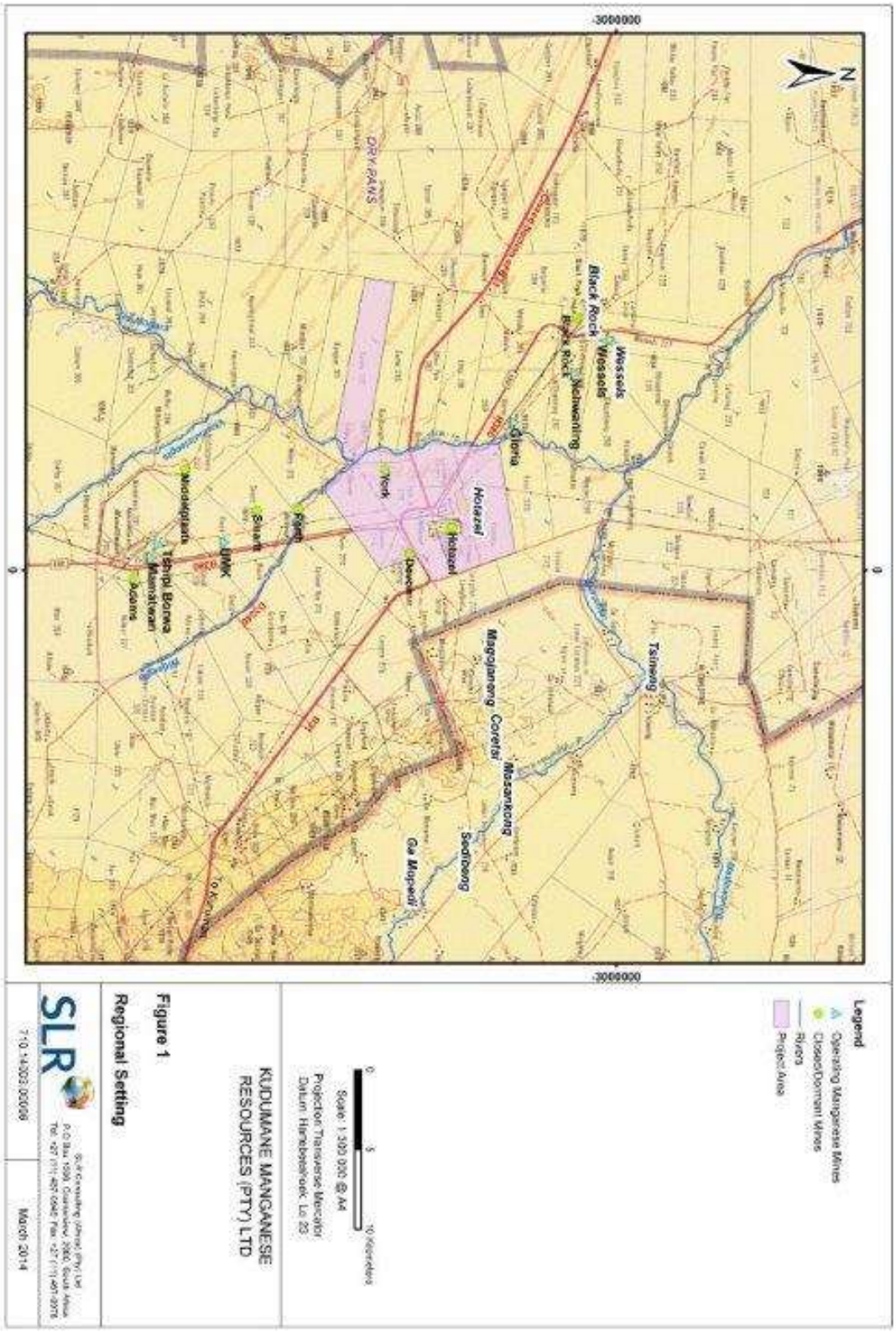

Figure 2.1 Regional setting of the Kudumane Manganese Project in the North West Province

3. GEOLOGY

The mining site is underlain by claystone, calcrete and dune sand of the Cretaceous to Tertiary Kalahari Formation, which is in turn underlain by remnants of the Dwyka tillite of the Karoo Supergroup and Proterozoic aged Hotazel Iron Formation and underlying Ongeluk lava Formation (Table 3.1) (Beukes, 1983 in Van der Merwe, 1997).

Table 3.1 Generalised Stratigraphic Column and Associated Geology

<table>
<tr><th colspan="4">Stratigraphy</th><th>Lithology</th></tr>
<tr><td colspan="4">Kalahari Formation</td><td>Sand, Clay, Limestone</td></tr>
<tr><td colspan="4">Karoo Supergroup</td><td>Dwyka Tillite</td></tr>
<tr><td colspan="3" rowspan="2">Olifantshoek Supergroup</td><td>Lucknow Formation</td><td>Quartzite</td></tr>
<tr><td>Mapedi Formation</td><td>Red and grey shale</td></tr>
<tr><td rowspan="10">Transvaal Supergroup</td><td rowspan="10">Postmansburg Group</td><td rowspan="9">Voelwater Subgroup</td><td>Mooidraai Formation</td><td>Dolomite</td></tr>
<tr><td rowspan="8">Hotazel Formation</td><td>Iron formation</td></tr>
<tr><td>Upper Mn ore body</td></tr>
<tr><td>Middle Mn ore body</td></tr>
<tr><td>Iron formation</td></tr>
<tr><td>Lower Mn ore body</td></tr>
<tr><td>Mn-rich iron formation</td></tr>
<tr><td>Iron formation</td></tr>
<tr><td colspan="2">Ongeluk Formation</td><td>Basaltic lava</td></tr>
</table>

3.1. Kalahari Formation

The Kalahari Formation is characterised by extensive sand dune deposits, with extensive outcrops of limestone along the banks of the GaMogara River (Figure. 3.1). The sequence of dune sand, calcareous sand, limestone and red claystone was evident at the old York Mine excavation on the Farm York 279, as illustrated in Figure 3.2 (see report 2011). The limestone is interbedded with prominent calcareous conglomerate beds with predominantly clasts of Ongeluk lava and scattered clasts of banded iron stone and Jaspelite as illustrated in Figure 3.3.

Figure 3.1 Limestone outcrops and sand dunes of the Kalahari Formation along the GaMogara River – GPS 27 14 15,4 S; 22 55 46,3 E

Figure 3.2 Excavation into the Kalahari Formation at the old York Mine. Exposure of sand dunes, calcareous sand, limestone and red clay stone

Figure 3.3 Conglomerate with poorly rounded pebbles of mainly Ongeluk lava in the calcareous Kalahari Formation

3.2. Pre-Kalahari Geology

The underlying geology of the Karoo and Transvaal Supergroups is not exposed, and borehole evidence confirms that the area is underlain by rocks of the Ongeluk lava and banded iron formations as illustrated in Figure 3.4.

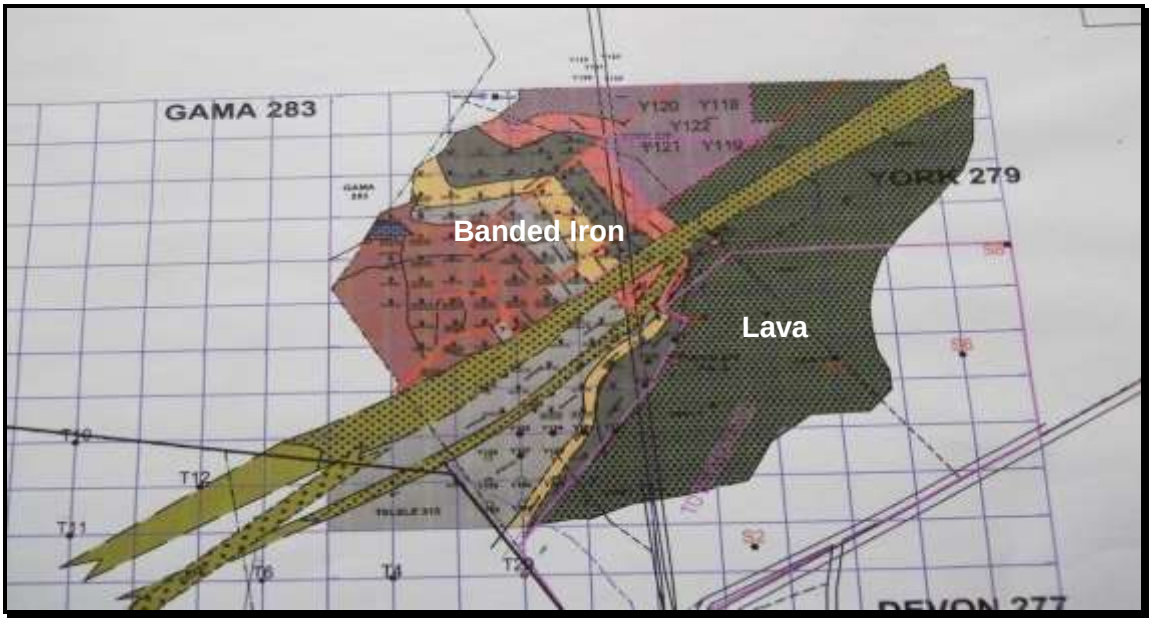

Figure 3.4 The geology underlying the Kalahari Formation. Confirmation of Pre-Kalahari geological formations in borehole data on the farm York 279

Generalised plan of the geology of the Transvaal Supergroup is provided by Beukes (1983) and Van der Merwe (1997) (Figure 3.5).

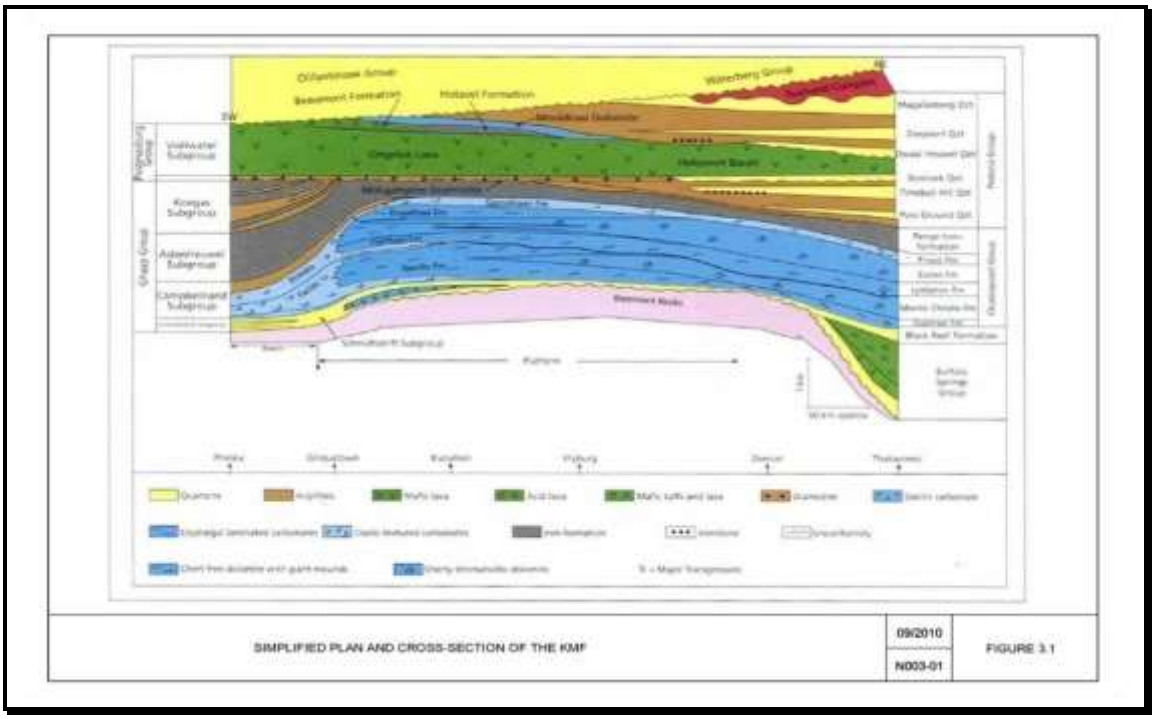

Figure 3.5 Generalised geological interpretation of the Transvaal Supergroup (Beukes, 1983, Kudumane EIA, 2010)

4. PALAEONTOLOGY

Literature reviews and reports associated with Heritage Conservation (Kudumane EIA 2010) make no mention of any palaeontological finds in the Kalahari Formation in this region. Although it is known that certain facies in the Dwyka Formation contains trace fossils and vertebrate fossils, the highly brecciated nature of the formation in this area will exclude fossils. Algal growth structures, known as "Stromatolites", are well-known fossil structures described from the dolomites of the Transvaal Supergroup.

4.1. Methodology

Field work for these investigations included a site visit of two days during which outcrops of specifically the Kalahari Formation was intensively surveyed for traces of vertebrate fossils in the limestone and calcareous sandstone. During the 2013 investigation no significant outcrops of potentially fossiliferous rocks were recorded on the farms Kipling 271, Hotazel 280, Devon 277 and Perth 276. Several borehole logs were investigated during 2011 to confirm algal structures and stromatolites in the dolomite and Banded Iron Formation (BIF) of the Mooidraai and Hotazel Formations. (see report of 2011)

4.2. Kalahari Formation

No record could be found of fossils from the Kalahari Formation close to Hotazel as also recorded during 2011.

Figure 4.1 Typical outcrops of the Kalahari limestone on the banks of the GaMogara River near Hotazel.

Figure 4.2 The York Mine works on the farm York 279 where limestone boulders were investigated for possible fossil content.

Figure 4.3 Limestone outcrops of the Kalahari Formation on the banks of the GaMogara River.

No fossil remains have been observed in the red claystone calcareous sandstone or dune sands on the farms Kipling 271, Hotazel 280, Devon 277 and Perth 276. There is a potential to find fossils in these lithological units during excavation for the open pit mining, and the observation of any possible fossils must be brought to the attention of the Environmental Control Officer of the Kudumane Manganese Project and SAHRA.

4.3. Pre-Kalahari Formations

The palaeontological importance of the Proterozoic Transvaal Supergroup is mainly associated with well-defined stromatolite structures in the dolomite deposits (Figure 4.6).

There are no outcrops of Pre-Kalahari Dwyka or older Transvaal Supergroup rocks in the study area and outcrops of the banded shale and thin dolomite zones that crop out on the main road between Hotazel and Kuruman shows very poorly defined algal structures that probably represent micro-stromatolites (Figure 4.7), as was recorded during 2011.

Small scale algal structures were observed in borehole logs made available on site (Figure 4.8) during 2011. The structures in the borehole logs are mostly of small (cm) scale and associated with banded iron formation or dolomite of the Hotazel Formation.

Figure 4.4 Typical stromatolite structures usually associated with dolomite deposits such as the dolomite of the Mooidraai Formation that overlies the Hotazel Formation. It is highly likely that structures such as in this photograph, might be exposed during exposure of the dolomite and Banded Iron Units in the Hotazel Formation (Photograph from Wikipedia 201) *en.wikipedia.org/wiki/Stromatolite.*

Figure 4.5 Poorly defined algal structures in outcrops of the Transvaal Supergroup between Hotazel and Kuruman.

Figure 4.6 Algal structures associated with banded iron units in the Hotazel Formation, as seen in some of the borehole logs in the study area.

5. FIELD INVESTIGATION 2013

Field visit to the farm Perth 276 confirms a lack of outcrop and a thick covering of tertiary sand and calcrete deposits. (Figures 5.1 to 5.4)

Field visit to the farm Hotazel 280 confirms that this farm has been highly developed, including the development of the Hotazel Mine as well as the town of Hotazel.

Field visit to the farm Kipling 271 also confirmed that the farm is underlain by red sand of the Kalahari Formation and no outcrops of potential fossiliferous rocks are exposed at the surface. Potential fossiliferous rocks might be exposed during mining activities.

The farm Devon 277 was investigated during 2011 and no outcrops were recorded. Potential fossiliferous rocks will only be exposed during mining operations.

Figure 5.2 General view of the environment on Perth 276

Figure 5.1 Outcrop of tertiary calcareous material (GPS: S27° 17' 46,7" E22° 58' 50,3")

Figure 5.3 Closed mine on Perth 276 (GPS: S27° 17' 24,7" E22° 57' 50,7")

Figure 5.4 A lack of outcrop is evident on Perth 276 (GPS: S27° 17' 02,5" E22° 57' 31,2)

Figure 5.5 Highly developed region of the farm Hotazel (GPS S27° 12' 26,8" E22° 57' 09,5")

Figure 5.6 Lack of outcrop on Hotazel 280 (GPS: S27° 11' 38,4" E22° 58' 09,0")

Figure 5.7 Lack of outcrop, representative of the farm Kipling 271

(GPS: S27° 11' 18,9" E22° 59' 47,6")

6. CONCLUSIONS

The Cretaceous to Tertiary Kalahari Formation overlies the entire study area and outcrops of the more resistant limestone are restricted to the banks of the GaMogara River.

No conclusive evidence of fossils could be found in either of the red claystone, conglomeratic limestone, calcareous sandstone or sand dunes of this formation and only two “pseudo-bone” remains have been recorded after two days of field investigations during 2011 (see report 2011).

The Proterozoic aged Hotazel Formation within the Kalahari Manganese Basin is host to the world’s largest land based manganese deposit. Three manganese-rich units are present within a banded iron formation (BIF) (Van der Merwe, 1997).

The mineralogical associations within the different iron formation facies reflect the chemistry of the environment during precipitation, leading to the formation of stromatolite structures when associated with algal growth.

After careful observation it is concluded that stromatolites might be present in the banded iron units of the Mooidraai Formation. From borehole log information it appears that the structures are poorly developed and are representative of micro-stromatolites if compared to the well-developed stromatolites in the dolomites of the Transvaal Supergroup.

Field work during 2011 and March 2013 confirms a lack of outcrop on the farms Kipling 271, Hotazel 280, Devon 277 and Perth 276 and no fossils were recorded.

7. RECOMMENDATIONS

7.1. Kalahari Formation

Palaeontological evidence is restricted to a few pseudo-bone structures that are preserved in the limestone. No evidence of any fossil material was collected from the rest of the Kalahari Formation.

It is recommended that the Environmental Control Officer be informed of the possibility of pseudo-bone fragments in the limestone and that it will be necessary to note any structure that might indicate bone material to a qualified Palaeontologist, who must then inform SAHRA of such a find. If such a find is recorded it will be necessary to research and compile a Phase II palaeontological report during the excavation of the open cast mine.

Underground mining activities will not have any impact on the Kalahari Formation.

7.2. Pre-Kalahari Formations

Palaeontological evidence is confined to micro-stromatolite structures in dolomites of the upper Mooidraai Formation and the banded iron units of the Hotazel Formation. The Environmental Control Officer must be aware of these structures and report the presence of stromatolites to the Mine Management and to SAHRA. It is recommended that, if recorded during open cast mining operations, a representative sample of at least $1m^3$ be collected before a permit is issued for the destruction of the stromatolites during future mining activities.

Due to the very specific targeting of Manganese ore bodies during future underground mining activities, the impact on stromalite structures will be negligible.

8. BIBLIOGRAPHY

Kudumane Manganese Project EIA Documentation (2010). Set of documents provided by Metago Environmental Engineers as background information to the Palaeontological Impact Report.

Van der Merwe SJ. 1997. Basin Analysis of the Kalahari Manganese Basin. Unpublished MSc Thesis, UOFS.

9. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989).

He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

10. DECLARATION OF INDEPENDENCE

I, Gideon Groenewald, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of palaeontological heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

Dr Gideon Groenewald

Geologist