



NGT ESH

Environment | Socio-Economics | Heritage

PROJECT TITLE:

PROPOSED MINING RIGHTS ON THE FARM WATERKLOOF 95 LOCATED BETWEEN
GRIEKWASTAD AND GROBLERSHOOP IN THE PIXLEY KA SEME DISTRICT
MUNICIPALITY WITHIN THE NORTHERN CAPE PROVINCE

PROJECT REFERENCE:

DATE OF ISSUE:

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SPECIALIST REPORT:

Palaeontological Impact Assessment for the proposed mining rights on the farm Waterkloof 95 located between Griekwastad and Groblershoop in The Pixley Ka Seme District Municipality within the Northern Cape Province

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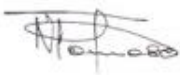
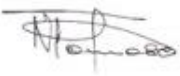
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NGT ESH takes full responsibility for its specialists working on the project for all heritage related matters based on the information provided by the clients. NGT ESH will not be responsible for any changes in design or changes in the nature of mining of the proposed project. Furthermore, any changes to the scope of works that may require significant amendments to the current heritage document will result in alteration of the fee schedule agreed upon with Kemu.

DECLARATION OF INDEPENDENCE

Marion Bamford has compiled this report on behalf of NGT ESH (*Appendix A*). The views expressed in this report are entirely those of the author and no other interest was displayed during the decision-making process for the project.

CONSULTANT:	NGT ESH SOLUTIONS
SPECIALIST NAME	Marion Bamford
QUALIFICATIONS	BSc, BSC Honours, MSc, PhD (Wits, 1990)
ASSOCIATION/PROFESSIONAL BODY	FRSSAf, mASSAf, PSSA, SASQUA
YEARS OF EXPERIENCE IN THE INDUSTRY	22
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CLIENT APPROVAL/SIGN OFF:

CLIENT:	KEMU HOLDINGS (PTY) LTD
SPECIALIST NAMES	Mr. Muneiwa Rakhalaru
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SIGNATURE (HAND SIGNATURE)	

EXECUTIVE SUMMARY

NGT ESHS, a subsidiary of NGT, was appointed by Kemu to conduct an PIA study for the proposed mining rights on the Farm Waterkloof 95 located between Griekwastad and Groblershoop. The receiving environment is located in SLM within PKSDM in Northern Cape Province, South Africa. The open pit mine will be called Phaphama Iron Ore Mine. To comply with SAHRA in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop PIA was completed for the proposed project.

Conclusions:

The proposed iron ore mine lies on iron formation rocks of the Rooinekke Formation (of the Koegas Subgroup, Ghaap Group, Transvaal Supergroup) and these are not fossiliferous. In the vicinity are dolomites and limestones of other formations of the Ghaap Group that could potentially contain stromatolites, although none has been recorded.

Recommendations:

Stromatolites are common trace fossils so it is recommended that if they will be disturbed by the mining operation then they should be put aside, and a palaeontologist asked to assess their scientific importance. If they are important then a SAHRA permit must be obtained by the palaeontologist for their removal from the site. This recommendation should be added to the EMP. As far as the palaeontology is concerned the project may proceed.

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LIST OF ABBREVIATIONS

ACRONYMS	DESCRIPTION
AUTHORITIES	
ASAPA	Association of South African Professional Archaeologists
ESHS	Environmental, Socio-Economic and Heritage Sustainability
NC-PHRA	Northern Cape Provincial Heritage Resources Authority
NGT	Nurture, Grow, Treasure
PKSDM	Pixley Ka Seme District Municipality
SAHRA	South African Heritage Resources Agency
SLM	Siyancuma Local Municipality
DISCIPLINE	
BAR	Basic Assessment Report
EIAs	Environmental Impact Assessment
EMPr	Environmental Management Programme
PIA	Palaeontological Impact Assessment
ToR	Terms of Reference
LEGAL	
NHRA	National Heritage Resources Act

TERMS AND DEFINITIONS

Palaeontological

- This means 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.
- The project area of this report is located in a moderate paleontological sensitive area.

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in the change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

- Construction, alteration, demolition, removal or change in use of a place or a structure at a place,
- Carrying out any works on or over or under a place.
- Subdivision or consolidation of land comprising a place, including the structures or airspace of a place.
- Constructing or putting up for display signs or boards; any change to the natural or existing condition or topography of land.
- And any removal or destruction of trees, or removal of vegetation or topsoil.
- The current development is for the proposed mining rights on the farm Waterkloof 95, Northern Cape Province

1. INTRODUCTION

NGT ESH, a subsidiary of NGT, was appointed by Kemu to conduct a PIA study for the proposed mining rights on the farm Waterkloof 95 located between Griekwastad and Groblershoopm (*Figure 1-2*). The receiving environment is located in the SLM in the PKSDM within the Northern Cape Province of South Africa.

The Phaphama prospecting right is located between Griekwastad (Griquatown) and Groblershoop in South Africa's Northern Cape Province and covers an area of 88 330 hectares. Motjoli acquired the Phaphama Prospecting Right (Ref: NC 30/5/1/2/11434 PR) from Aquila Steel South Africa Pty (Ltd) (Aquila) in 2017. The principal Prospecting Right (Ref: NC 30/5/1/1/2/1023 PR) was renewed and ceded on granting to Motjoli. Access is by the Griquastad-Groblershoop main bitumen road and secondary gravel roads south to Prieska and north to Postmasburg. The Phaphama prospecting right is situated approximately 65km south of Kumba Iron Ore's Kolomela Iron Ore Mine. An iron ore resource was identified by Aquila on Farm Waterkloof 95, a property and a component of the Phaphama Prospecting Right, hence the project has since been referred to as Phaphama iron ore project, "Phaphama". Exploration campaigns on Phaphama saw a completion of 94 reverse circulation drilling which informed a 10.46Mt estimation of the mineral resource. Additional and infill diamond core drilling is envisaged to increase and upgrade the mineral resource status towards and during mine development (*Figure 3*).

The proposed site for the mine is the Remainder of farm Waterkloof 95 is about 45 km west of Griekwastad. The area of the farm is 2180,5506 ha and the Waterkloof farm is to be mined as an open pit by means of conventional truck and shovel mining techniques.

A PIA was requested for the proposed mine and the whole farm is considered in this report.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014)

A SPECIALIST REPORT PREPARED IN TERMS OF THE ENVIRONMENTAL IMPACT REGULATIONS OF 2014 MUST CONTAIN:	RELEVANT SECTION IN REPORT
Details of the specialist who prepared the report	Appendix A
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A
A declaration that the person is independent in a form as may be specified by the competent authority	Page Error! Bookmark not defined.
An indication of the scope of, and the purpose for which, the report was prepared	Section Error! Reference source not found.
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 0 Error! Reference source not found.
An identification of any areas to be avoided, including buffers	N/A
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 0
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
Any mitigation measures for inclusion in the EMPr	n/a
Any conditions for inclusion in the environmental authorisation	n/a
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	n/a
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	N/A
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	N/A
A description of any consultation process that was undertaken during the course of carrying out the study	N/A
A summary and copies if any comments that were received during any consultation process	N/A
Any other information requested by the competent authority.	N/A

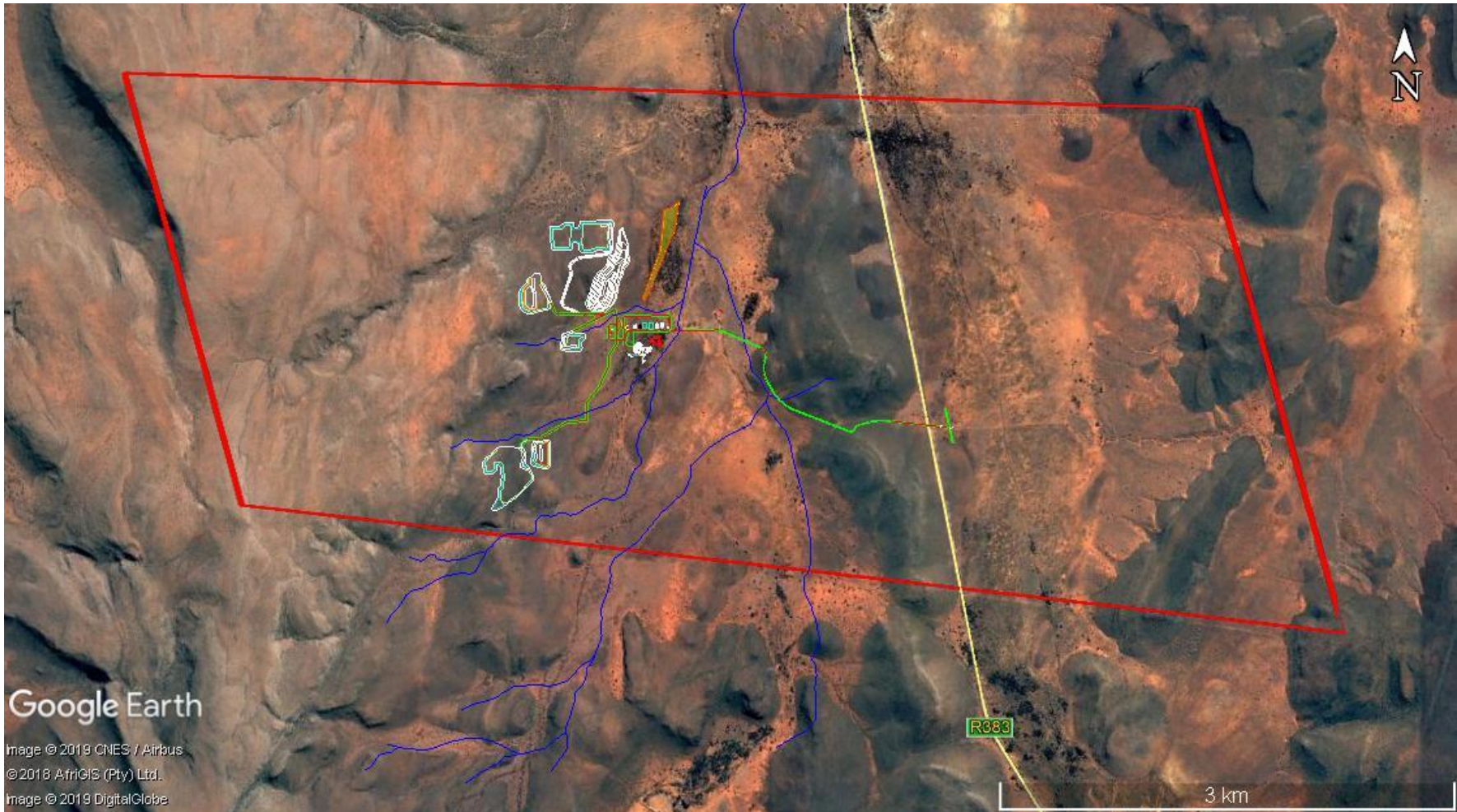


Figure 1: Google Earth map showing the boundaries of the farm Waterkloof 95, within the Phaphama project area.

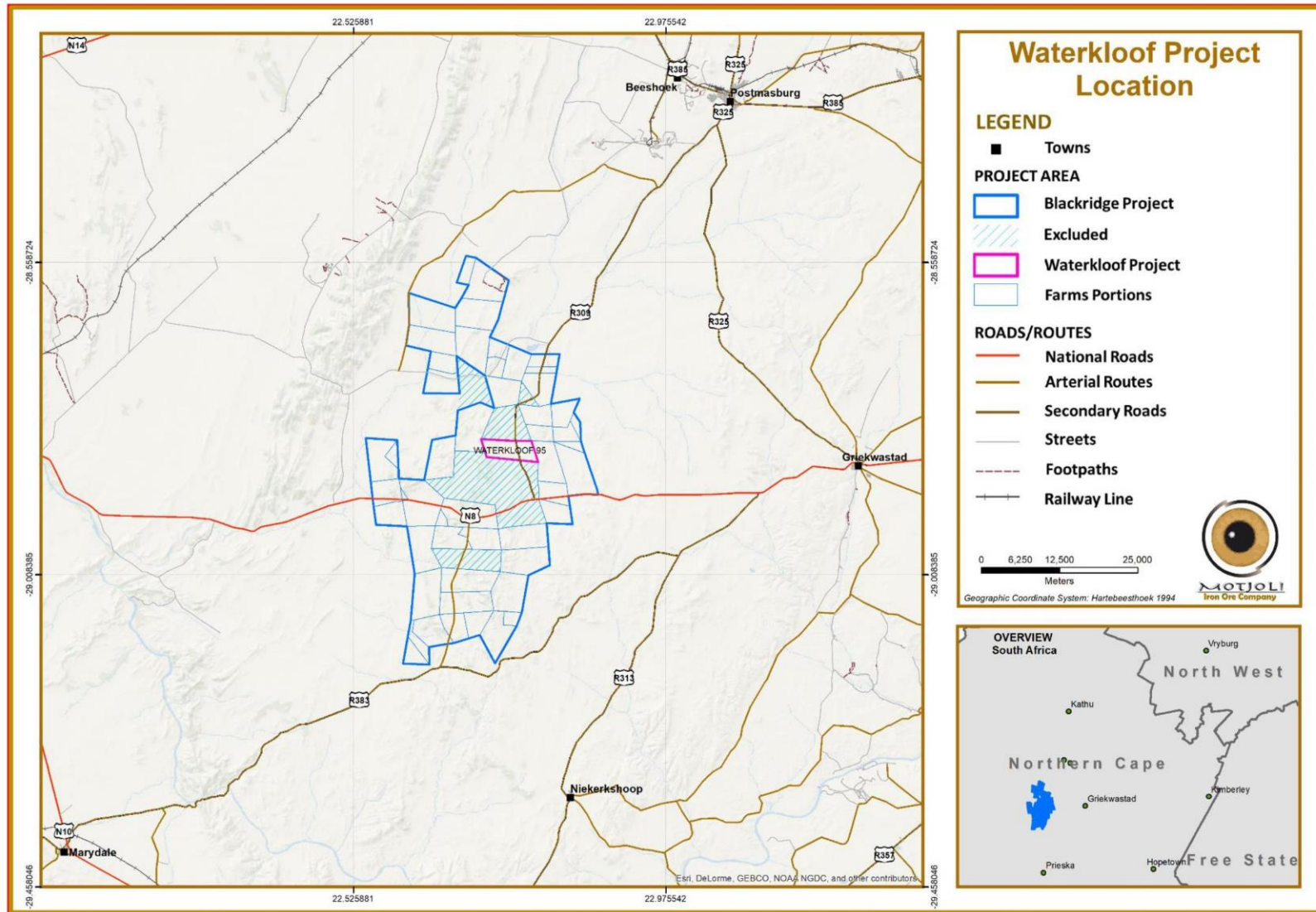


Figure 2: Topographic map showing the Phaphama project area and Waterkloof 95 farm (red) that is under consideration for an iron ore mine.

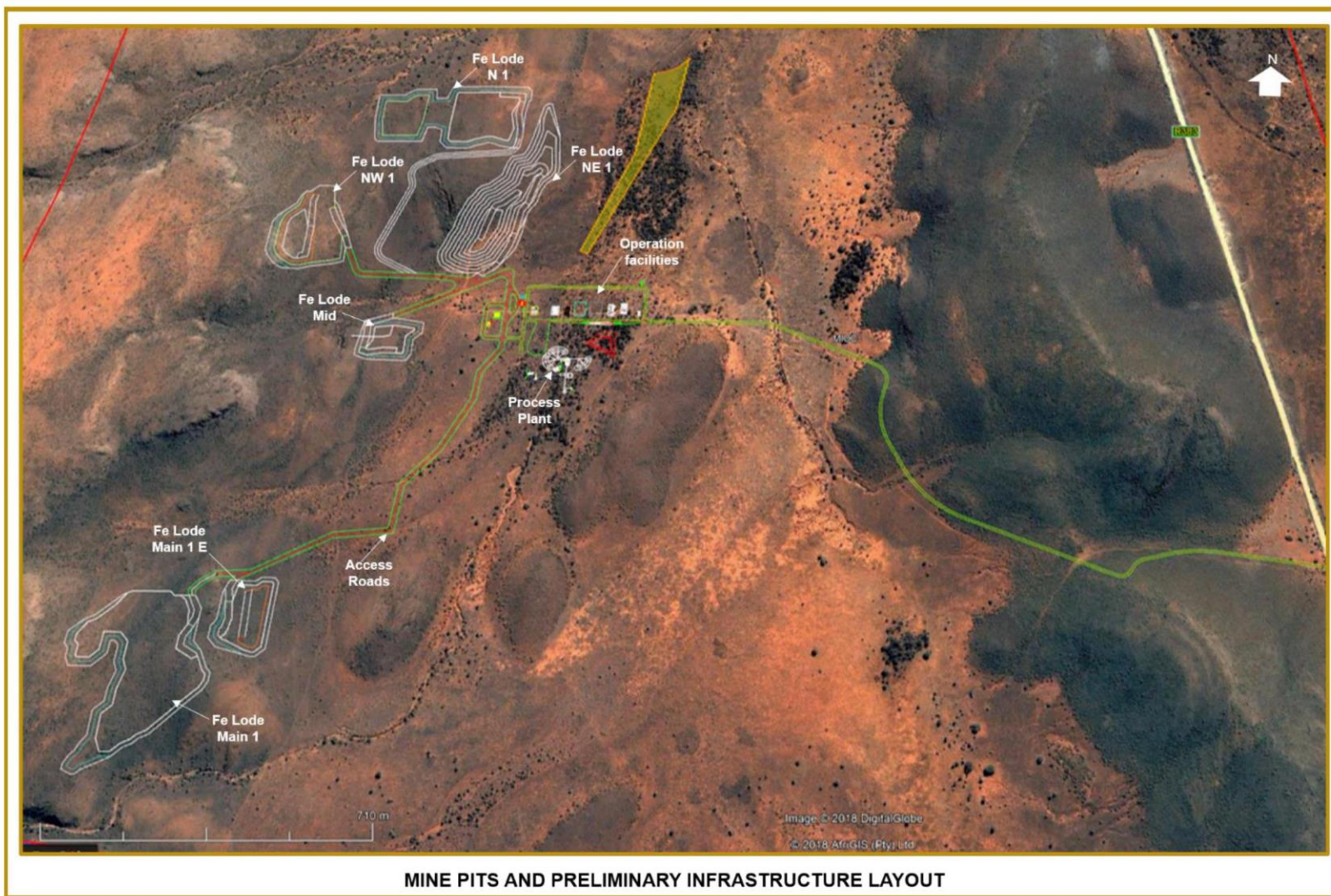


Figure 3: Google Earth map with overlay of the mine plan and infrastructure for Phaphama Iron Ore Mine.

2. METHODS AND TERMS OF REFERENCE

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.

The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases.
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*).
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*).
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected.

3. GEOLOGY AND PALAEOONTOLOGY

3.1. Project location and geological context

The Transvaal Supergroup (Late Archean to Early Proterozoic) is preserved in three structural basins on the Kaapvaal Craton of southern Africa and the strata are mostly horizontal except in the Griqualand Basin where extensive deformation has complicated the geology around the Maremane Dome (Eriksson *et al.*, 2006). The various formations represent different phases of the gradual infilling of a subsiding but tectonically active basin and epeiric sea.

The farm Waterkloof 95 lies on the iron formation of the Rooinekke Formation (Koegas Subgroup, Ghaap Group, Transvaal Supergroup) with outcrops of the other Formations of the Ghaap Group that are composed of mudstone and dolomites (*Figure 4, Table 2*). There are also dolomites of the Makganyene Formation in the area as well as andesites of the Ongeluk and Heynskop Formations.

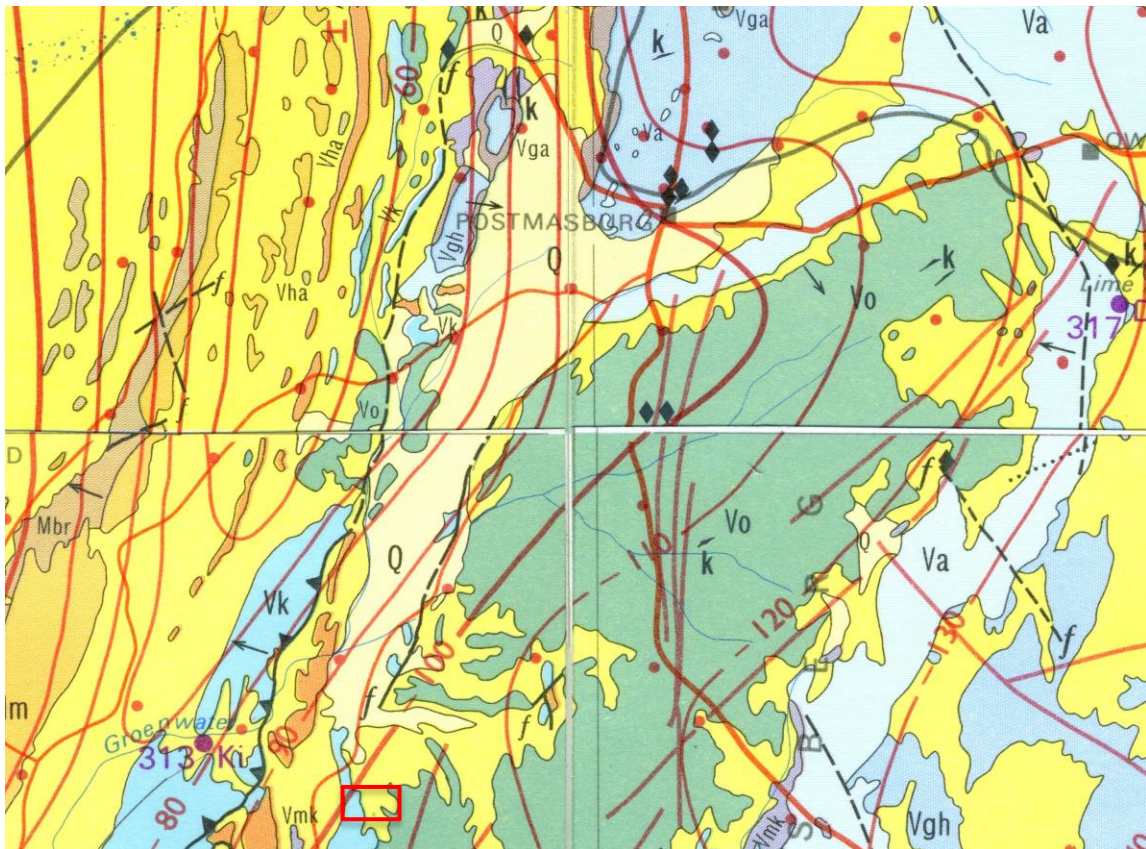


Figure 4: Geological map of the area south of Postmasburg. The location of the proposed mine is indicated by the arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map, 1984.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson *et al.*, 2006; Frauenstein *et al.*, 2009). SG = Supergroup; Fm = Formation; Ma = million years.

SYMBOL	GROUP/FORMATION	LITHOLOGY	APPROXIMATE AGE
Q	Quaternary	Alluvium, sand, calcrete	Neogene, ca 25 Ma to present
Q	Quaternary	Sands, alluvium, calcrete	Last 2.5 Ma
T/Qk	Tertiary overlying Kalahari Sands	Soils, sands, alluvium, calcrete	Last ca 25 Ma
Vga	Gamagara Fm, Postmasburg Group, Transvaal SG.	Shale, quartzite, conglomerate	
Vo	Ongeluk Fm, Fm, Postmasburg Group, Transvaal SG.	Andesite	
Vmk	Makganyeni Fm, Postmasburg Group, Transvaal SG.	Diamictite, dolomite, chert	
Vk	Rooinekke Fm, Koegas Subgroup, Ghaap Group, Transvaal SG	Iron formation	
Va	Asbestos Hills Group, Transvaal SG.	Iron formation, jaspilite	
Vgh	Ghaap Plateau, Transvaal SG. (includes Campbellrand Subgroup)	Dolomite, limestone, chert	

The geology in the Griqualand West area is dominated by the ancient Transvaal Supergroup rocks with overlying Kalahari sands that are Quaternary in age. Subgroups and Formations in this area have different names from those in the Transvaal Basin and various attempts have been made to correlate them (see reviews in Eriksson *et al.*, 2006; Frauenstein *et al.*, 2009; Fairey *et al.*, 2013).

3.2. Palaeontological context

Andesites are extrusive rocks and do not contain fossils. Iron formation, although linked to the early oxygenation of the earth when photosynthesising bacteria and algae released oxygen that was quickly taken up by iron to form haematite, does not preserve the microbes, and so is not fossiliferous. Dolomites can contain stromatolites which are the trace fossils of other early algal colonies. Stromatolites are the layer upon layer of minerals that were laid down, in various morphologies, by the photosynthesising colonies. The minerals include calcium carbonate, calcium sulphate, magnesium carbonate and magnesium sulphate. Very rarely the microbes (unicellular blue-green algae and green algae) are preserved in the stromatolites but this is extremely rare and requires thin sectioning and study under a petrographic microscope to see the microbes.

The rocks to be mined for iron ore are not fossiliferous but the dolomites and limestones might contain some stromatolites.

From the SAHRIS palaeo-sensitivity map below (*Figure 5*), the project area falls within an area that has moderate sensitivity (green) so a desktop study is presented here. The Rooinekke Formation (iron formation) is not distinguished from the rest of the Ghaap Group, some formations of which are composed of dolomite.

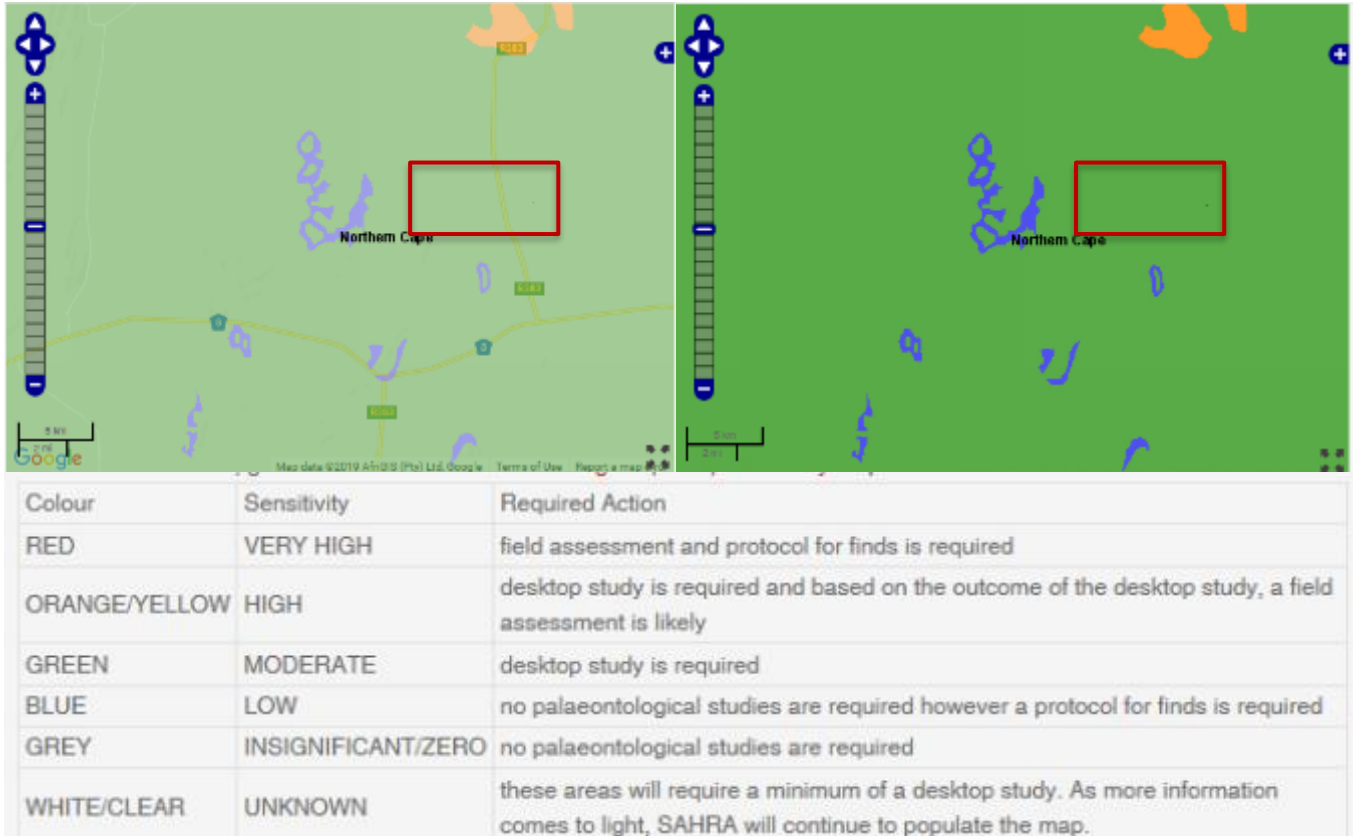


Figure 5: SAHRIS palaeosensitivity maps for the proposed routes for the proposed Phaphama Iron Ore Mine. The farm is indicated within the yellow outline.

4. IMPACT ASSESSMENT AND RATINGS

Table 3: Impact assessment definitions and criteria.

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	H	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	L	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	L	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	H	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

Table 4: Impact assessment results for this project

PART B: Assessment		
SEVERITY/NATURE	H	-
	M	-
	L	Although fossil microbes have been reported from the stromatolites in other dolomites, they are very rare, scattered and it is difficult to predict where they will occur.
	L+	-
	M+	-
	H+	-
DURATION	L	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	L	Since only the possible fossils within the area would be the trace fossil stromatolites, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	It is very unlikely that any fossils would be found in the surface sands or soils, but stromatolites might occur below ground or in rocky outcrops. Therefore, a Fossil Chance Find protocol should be followed once mining commences.

Based on the nature of the project, surface activities would not impact upon the fossil heritage even if preserved, because the area has already been very weathered naturally. The geological structures suggest that there might be outcrops of dolomite near the iron formation of the Rooinekke Formation. Stromatolites are trace fossils and very common in some parts of the country, but they are of very little

interest to palaeontologists or geologists. Nonetheless they should be put aside and protected until a geologist or palaeontologist can assess their scientific importance. Taking account of the defined criteria, the potential impact to fossil heritage resources is very low.

5. ASSUMPTIONS AND UNCERTAINTIES

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the andesites, conglomerates, granites, sandstones, shales and sands are typical for the country and are too old to contain any body fossils. Dolomites might contain stromatolites, but these are of little interest to palaeontologists. They have not been well studied in this area and their occurrence has not been confirmed.

6. RECOMMENDATION

Based on experience and the lack of any previously recorded fossils from the area, it is unlikely that any trace fossils would be preserved in the dolomites, such as stromatolites. There is an extremely small chance that fossil microbes might be preserved in the stromatolites, if they are present. Based on this it is recommended that any stromatolites found once excavations and mining commence, are put aside and a representative sample protected for a palaeontologist or geologist to assess for their scientific importance. If they are considered to be important a SAHRA permit must be obtained by the palaeontologist so that the stromatolites can be removed and housed in a recognised institution such as museum or university that has a palaeontology department. As far as the palaeontological heritage is concerned, the project can continue, and the recommended treatment of stromatolites should be added to the EMPr.

7. REFERENCES

Eriksson, P.G., Altermann, W., Hartzler, F.J., 2006. The Transvaal Supergroup and its pre-cursors. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. pp 237-260.

Fairey, B., Tsikos, H., Corfu, F., Polteau, S., 2013. U–Pb systematics in carbonates of the Postmasburg Group, Transvaal Supergroup, South Africa: Primary versus metasomatic controls. *Precambrian Research* 231, 194– 205.

Frauenstein, F., Veizer, J., Beukes, N., Van Niekerk, H.S., Coetzee, L.L., 2009. Transvaal Supergroup carbonates: Implications for Paleoproterozoic $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ records. *Precambrian Research* 175, 149–160.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

8. APPENDIX A – DETAILS OF SPECIALIST

Curriculum vitae (short) - Marion Bamford PhD

January 2019

i) Personal details

Surname : **Bamford**

First names : **Marion Kathleen**

Present employment : Professor; Director of the Evolutionary Studies Institute.
Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa-

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ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:

1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.

1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.

1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.

1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) Professional qualifications

Wood Anatomy Training (overseas as nothing was available in South Africa):

1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps

1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer

1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa
 Royal Society of Southern Africa - Fellow: 2006 onwards
 Academy of Sciences of South Africa - Member: Oct 2014 onwards
 International Association of Wood Anatomists - First enrolled: January 1991
 International Organization of Palaeobotany – 1993+
 Botanical Society of South Africa
 South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
 SASQUA (South African Society for Quaternary Research) – 1997+
 PAGES - 2008 –onwards: South African representative
 ROCEEH / WAVE – 2008+
 INQUA – PALCOMM – 2011+onwards

vii) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	6	1
Masters	8	1
PhD	10	2
Postdoctoral fellows	9	3

viii) Undergraduate teaching

Geology II – Palaeobotany GEOL2008 – average 65 students per year
 Biology III – Palaeobotany APES3029 – average 25 students per year
 Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology;
 Micropalaeontology – average 2-8 students per year.

ix) Editing and reviewing

The PIA developed by NGT ESH Solutions for NGT Holdings on behalf of Kemu Holdings (Pty) Ltd and Motjoli Iron Ore Company (Pty) Ltd

Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor

Guest Editor: Quaternary International: 2005 volume

Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Cretaceous Research: 2014 -

Review of manuscripts for ISI-listed journals: 25 local and international journals

x) Palaeontological Impact Assessments

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources
- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT

- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klippoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells

xi) Research Output

Publications by M K Bamford up to June 2018 peer-reviewed journals or scholarly books: over 125 articles published; 5 submitted/in press; 8 book chapters.

Scopus h index = 26; Google scholar h index = 30;

Conferences: numerous presentations at local and international conferences.

xii) NRF Rating

NRF Rating: B-2 (2016-2020)

NRF Rating: B-3 (2010-2015)

NRF Rating: B-3 (2005-2009)

NRF Rating: C-2 (1999-2004)