Palaeontological Impact Assessment for the proposed glass bottle manufacturing plant, farm Leeuwkuil 596 IQ, Vereeniging, Gauteng Province

Desktop Study

For

SLR Consulting (South Africa) (Pty) Ltd

21 July 2018

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Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 30 years research; 22 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by SLR Consulting (South Africa) (Pty) Ltd, Johannesburg, South Africa. 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.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

The site for the proposed glass bottle manufacturing plant for SAB, on Portion 238 of Farm Leeuwkuil 596 IQ, near Vereeniging, southern Gauteng is on rocks of the Vryheid Formation, early Ecca, early Permian and could potentially contain impressions of plants of the *Glossopteris* flora. Logs from two borehole cores (BH3, north; BH4, south) show that the underlying rocks comprise soils, weathered clays, weathered shales and quartzite and these would not preserve any fossils because they are very weathered clays or shales which would have destroyed any possible fossils. Potentially fossiliferous shales occur below 20 and 35m below the surface and this is well below the projected maximum depth of 12m for the piling. Nonetheless a Chance Find Protocol is included because the SAHRIS map indicates that area is highly sensitive paleontologically.

As far as the palaeontological heritage is concerned the project can continue and no further assessment is required but the on-site responsible person should monitor the excavations.

Table of Contents

1. Background

Introduction

The South African Breweries (Pty) Limited (SAB), with Black owned partner(s), is proposing to develop and operate a majority Black owned glass bottle manufacturing plant on Portion 238 (a portion of Portion 149) of the Farm Leeuwkuil 596 IQ. The property is owned by SAB and borders Lager Avenue, the R59 and R28 roads. The site is located within the Emfuleni Local Municipality in Vereeniging, Gauteng Province. Refer to Figure 1 for the local setting of the project.

Figure 1: Detailed map from Google Earth of the proposed glass bottle manufacturing plant (white outline) on farm Leeuwkuil Ext 5, Vereeniging, southern Gauteng. Map supplied by SLR Consulting (South Africa) (Pty) Ltd.

Environmental Authorisation Process

In order for the proposed glass bottle manufacturing plant to go ahead, SAB must obtain Environmental Authorisation, a Waste Management Licence and an Atmospheric Emissions Licence. A Scoping and Environmental Impact Assessment (EIA) process, in terms EIA Regulations 2014, is required to inform an Environmental Authorisation and a Waste

Management Licence decision from the Gauteng Department of Agriculture and Rural Development in terms of section 24(5) of the National Environmental Management Act (NEMA) (No. 107 of 1998) and the National Environmental Management Waste Act (NEMWA) (No. 59 of 2008) respectively.

The proposed glass bottle manufacturing plant would produce green and amber coloured bottles. The facility would comprise a batch plant, main manufacturing building and warehouse. The maximum excavation depth for foundations on the project is likely to be between 2 and 4 m. Depending on the loading, piling may be required for some structures, this may extend to between 10 and 12 m. These depths may change.

This report is the palaeontological impact assessment for the project.

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 B
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
An indication of the scope of, and the purpose for which, the report was prepared	Section 1
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 0
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section ii **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 5
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	Appendix 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

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 the South African Heritage Resource Agency (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;

3. Geology and Palaeontology

i. Project location and geological context

The site for the proposed project lies on the shales and sandstones of the Vryheid Formation, Ecca Group that are early Permian in age (Figure 2, Table 2). Nearby are the ancient Klipriviersberg Group (Ventersdorp Supergroup) mafic and felsic lavas, quartzites, shales conglomerates, and the shales, quartzite, conglomerate, breccia and diamictites of the Timeball Hill and Rooihoogte Formations (Pretoria Group). To the east, north and south are a variety of ancient rocks of the Witwatersrand Supergroup and the Pretoria Group, ranging in age from 3340 to 2150 Ma (million years). These rocks are all volcanic (produced by early volcanic activity, i.e, igneous rock that came up to the surface) or plutonic (igneous rock that solidified far below the earth's surface) in origin, and do not preserve fossils.

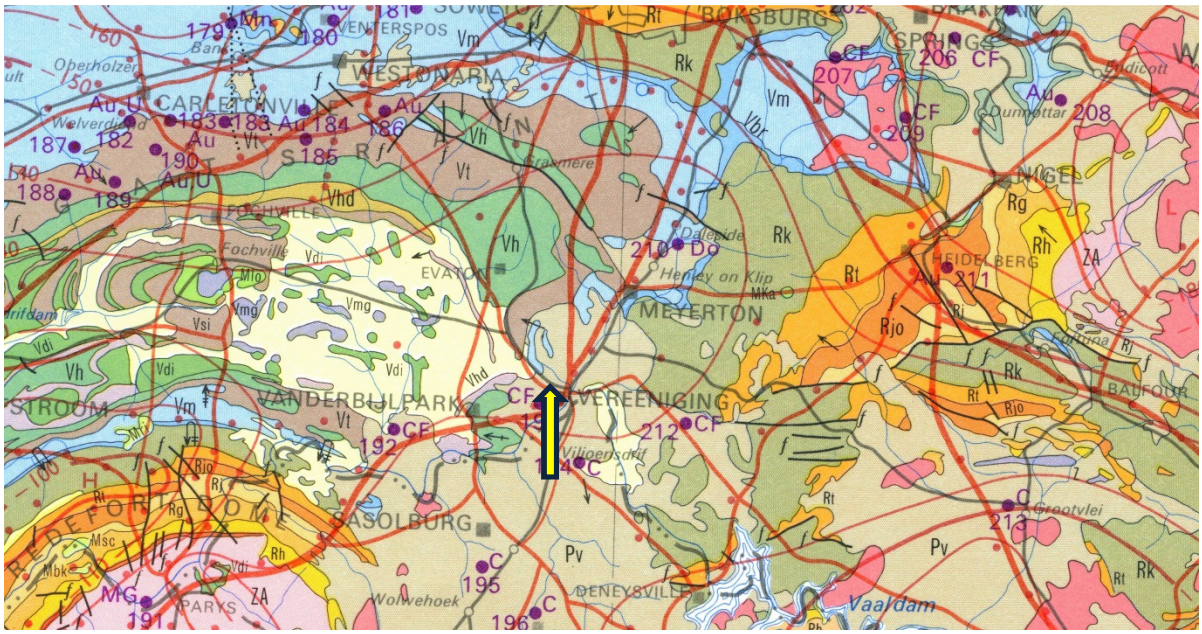


Figure 2: Geological map of the area around Vereeniging, southern Gauteng Province, where the proposed glass bottling plant will be constructed, on Farm Leeuwkuil 596 IQ. The proposed site is indicated by the yellow arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

Table 2: Explanation of symbols for the geological map and approximate ages (McCarthy, 2006; Robb et al., 2006). SG = Supergroup; Fm = Formation.

Symbol	Group/Formation	Lithology	Approximate Age
Jd	Jurassic dolerite dykes	Dolerite	Ca 180 Ma
Pv	Vryheid Fm, Ecca Group	Sandstone, shale, coal	Early Permian 296-269 Ma
C-Pd	Dwyka	Tillite, sandstone, mudstone, shale	Upper Carboniferous, Early Permian 295-290 Ma
Vhd	Dwaalheuvel, Strubenkop and Daspoort Fms; Pretoria Group	Andesite, sandstone, shale	
Vh	Hekpoort Fm, Pretoria Group	Basaltic andesite, pyroclastic rocks	2224 Ma
Vti	Timeball Hill and Rooihoogte Fm, Pretoria Group	Shale, quartzite, conglomerate, breccia, diamictite	Ca 2420 Ma
Vm	Malmani subgroup, Chuniespoort Group	Dolomite, chert	2642 – 2500 Ma
Vbr	Black Reef Fm	Quartzite, conglomerate, shale, basalt	>2642 Ma
Vdi	Diabase	Diabase	

Symbol	Group/Formation	Lithology	Approximate Age
Rk	Klipriviersberg Group, Ventersdorp Supergroup	Mafic and felsic lavas, quartzites, shales conglomerates	Late Archaean >2700 Ma
Rw	Witwatersrand Supergroup (undifferentiated)	Quartzite, shale	Ca 2950 – 2750 Ma
Rt	Turfontein Subgroup, Central Rand Group, Witwatersrand SG	Conglomerate, quartzite	
Rjo	Johannesburg Subgroup, Central Rand group, Witwatersrand SG	Quartzite, conglomerate, shale	
Rg	Government Subgroup, West Rand Group, Witwatersrand SG	Quartzite, shale	
Rh	Hospital Hill, West Rand Group, Witwatersrand SG	Shale, quartzite	
Z, Zhh	Basement complex of the Johannesburg Dome	Gneiss, migmatite, granodiorite	3340 Ma

ii. Palaeontological context

Only the rocks of the Vryheid Formation are potentially fossiliferous as they are the part of the sedimentary Karoo Basin and are the main coal forming strata of southern Africa. While coals are formed from the peats that developed in deltas, shallow basins or mires, the plants have become so compressed and altered by burial (overburden) and heat that the original plant structure is not preserved. Coals *per se* are of very limited palaeontological interest but the shales and mudstones associated with coals sometimes have impressions of the original plants preserved within them. Un-weathered shales and mudstones could, therefore, contain impressions of plants of the *Glossopteris* flora, namely glossopterid leaves, fructifications, fern fronds, lycopods, sphenophytes and possible gymnosperms.

Insect impressions occur with leaf floras but it is very rare to find any vertebrates associated with leaf floras, moreover during the Early Permian vertebrates were extremely rare.

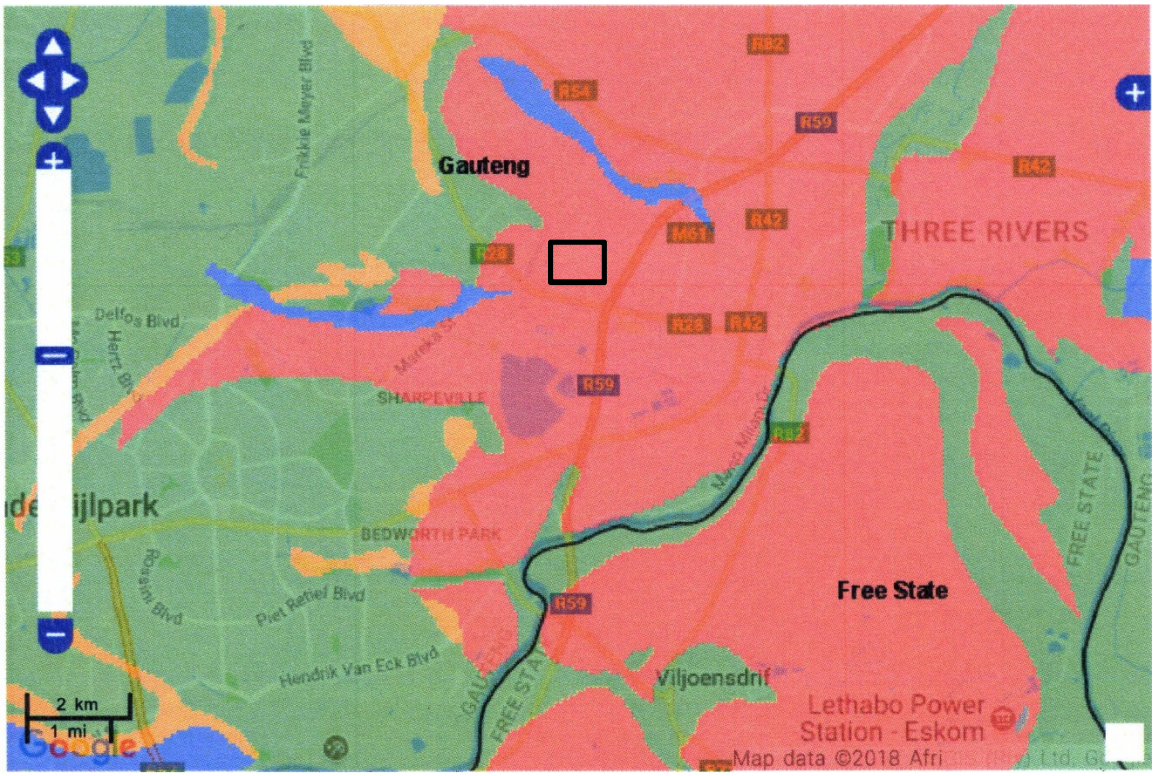


Figure 3: SAHRIS palaeosensitivity map of the region around Vereeniging, and the Farm Leeuwkuil in particular. The site is in the red area (black rectangle). Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

Although the SAHRIS palaeosensitivity map (Figure 3) indicates that the area is highly sensitive the borehole core logs do not support this.

Borehole cores have been done recently for the project, and the cores are of BH3 and BH4 are shown here (Figures 4 and 5). Bother were drilled to a depth of 60m. In BH3 (north) the top 17m is composed of various facies of weathered clay and would not preserve fossils, even if they had been present initially. The weathered shales from 17-19m, likewise would not have fossil impressions preserved in it. Only the black shale from 35m downwards could potentially preserve fossils and this is way below the depth of any proposed construction for this project. BH 4 (south) is different (reflecting the well-known very variable topography of the underlying Karoo Basin (Johnson et al., 2006)) with top soil down to 4m, then silty clay from 4-11m, and silty clay with decomposed quartz from 11-19m that indicated deep weathering. Only the competent shale from 20-45m deep could potentially preserve fossil plants. The project is not projected to excavate below 12m depth.

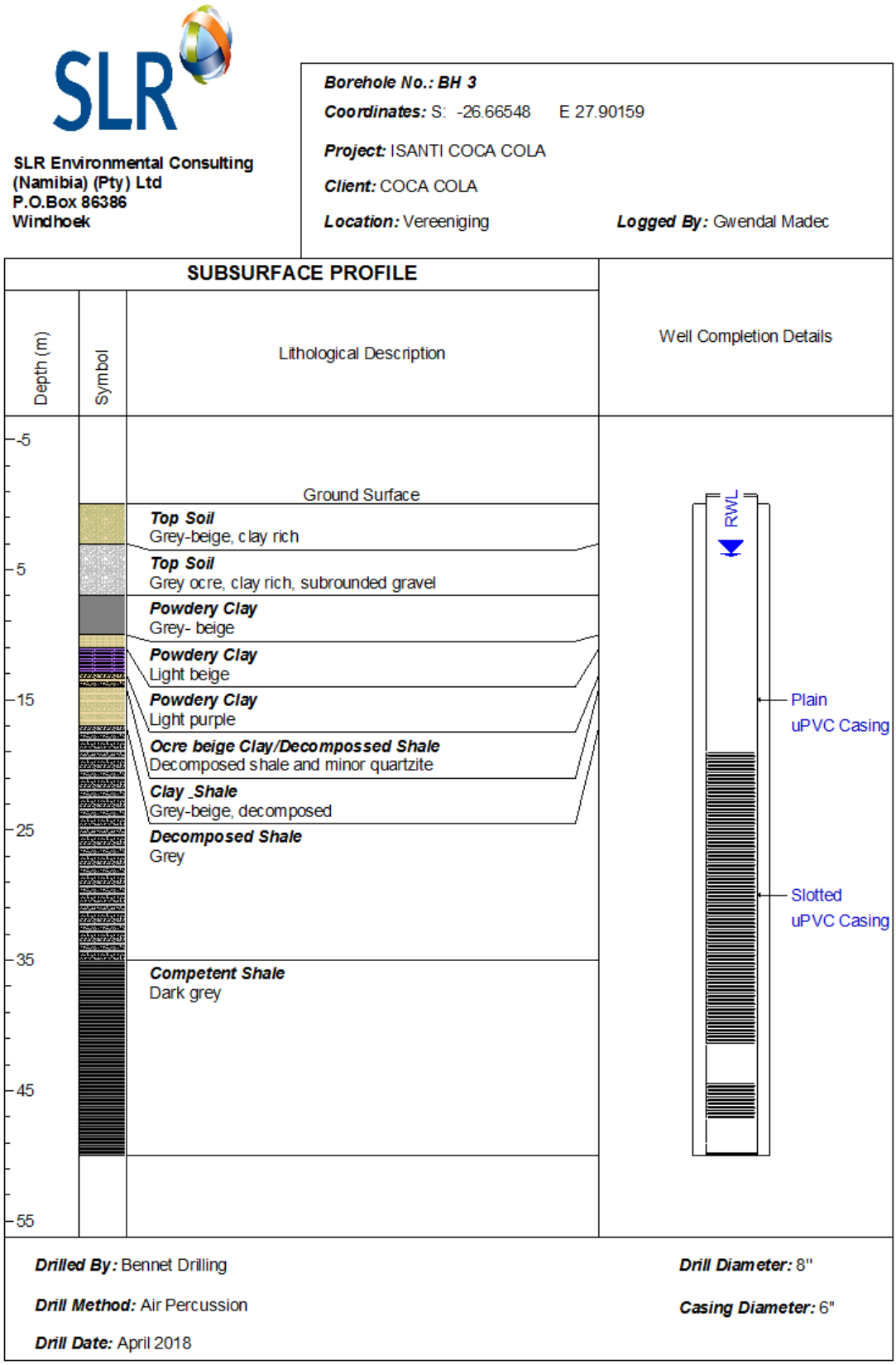


Figure 4: Borehole log no BH3 from the northern part of Portion 238 of the farm Leeuwkuil 596 IQ.

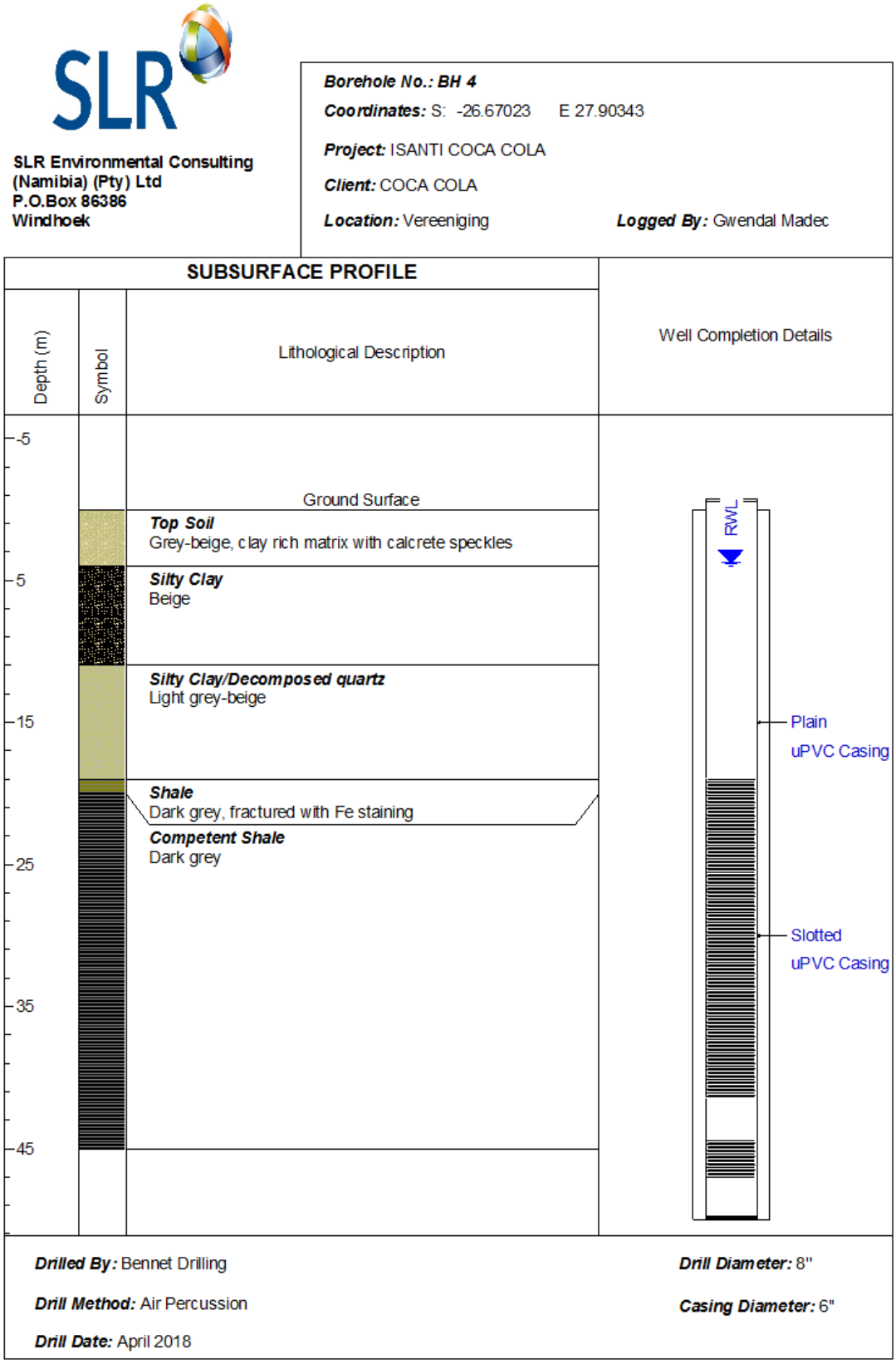


Figure 5: Borehole log no BH4 from the northern part of Portion 238 of the farm Leeuwkuil 596 IQ.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

TABLE 3A: CRITERIA FOR ASSESSING IMPACTS

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 3B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	**H**	-
	M	-
	L	There is a small chance of fossils being found here
	L+	-
	M+	
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	The spatial scale is extremely small.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	
	L	Based on the borehole cores there is no chance of finding fossils in the gravels, soils, weathered clays and shales of the Vryheid Formation, as expressed here.

Based on the nature of the project, the foundations for the glass bottling plant will penetrate the ground to a depth of 2-4m, with piling possibly up to 12m if unstable dolomites are encountered. There are no potentially fossiliferous rocks above 35m in the north and above 20 m in the south as has been determined by drilling. The proposed project, therefore will not impact on any potentially fossiliferous rocks. However, the SAHRIS palaeosensitivity map indicates that fossils should be in this area, so a Chance Find Protocol has been added to this report (Appendix A and Figure 6) and should be included in the environmental management programme EMPr. Taking account of the defined criteria, the potential impact to fossil heritage resources is nil.

5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, there is a chance of finding fossil plant impressions in the shales and mudstones of the Vryheid Formation. However, relying on the borehole core logs, it can be assumed that the formation and layout of the soils, weathered clays, weathered shales and quartzites, although of the correct age and primary context, do not contain any fossils in this particular area. Furthermore, no fossils have been reported from this region. Nonetheless a Chance Find Protocol is included.

6. Recommendation

Based on the age and type of sediments there is a chance of finding fossils but because the borehole logs show no suitable sediments in the site, it is extremely unlikely that the project would impact on the fossils. As far as the palaeontological heritage is concerned construction of the proposed glass bottle manufacturing plant can proceed. A Chance Find Protocol is included in the event that the construction engineer, environmental officer or responsible person sees fossil plants once excavations have commenced.

7. References

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., 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. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

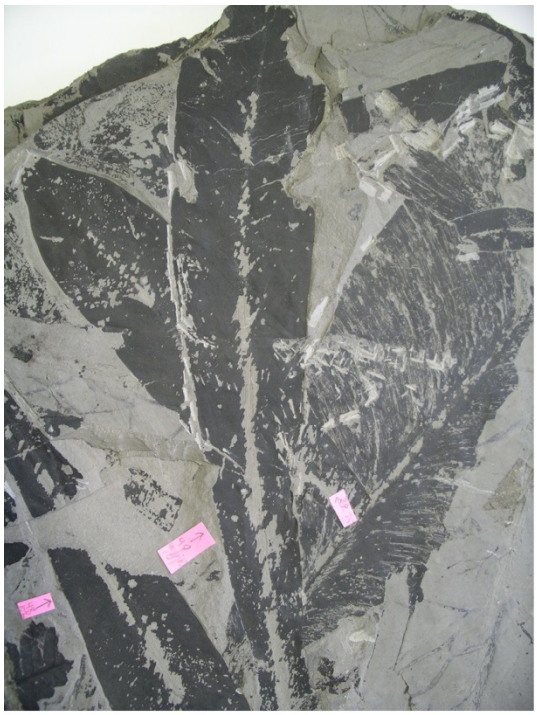
McCarthy, T.S., 2006. The Witwatersrand Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 155-186.
Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Robb, L.J., Brandl, G., Anhaeusser, C.R., Poujol, M., 2006. Archaean Granitoid Intrusions. 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 57-94.

Appendix A: Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations begin.

1. The following procedure is only required if fossils are seen on the surface and/or during construction excavations .
2. When construction begins (for site leveling) the rocks must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, plants, insects, bone, coal) should be put aside in a suitably protected place. This way the construction activities will not be interrupted.
3. Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones (for example see Figure 6). This information must be built into the EMPr's training and awareness plan and procedures.
4. Photographs of the presumed fossils should be sent to a palaeontologist for a preliminary assessment.
5. As and when required, a palaeontologist should visit the site to inspect the selected material that has been retrieved by the geologist before crushing, removal or disposal. The frequency of inspections should be determined by the amount of material put aside and the response of the palaeontologist on the photographs sent to him/her of the potential fossils.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, location GPS recorded, plus stratigraphy recorded, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits (should they be required).
7. A final report by the palaeontologist must be sent to SAHRA once the construction has been completed, if there are any fossils found.
8. If no fossils are found at completion of construction, then no further monitoring is required.



Wide and narrow Glossopteris leaves

Narrow Glossopteris leaves

Lycopod stem with leaf abscission scars

Astertotheca (fern)

Hammanskraal fossil plants

Figure 6: Examples of fossil leaves that could occur in the Vryheid Formation.

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
July 2018

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-
Telephone	:	+27 11 717 6690
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Cell	:	082 555 6937
E-mail	:	marion.bamford@wits.ac.za ; marionbamford12@gmail.com

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	5	2
Masters	6	3
PhD	9	3
Postdoctoral fellows	5	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
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
- Klipoortjie and Finaalspan 2017 for Delta BEC

xi) Research Output

Publications by M K Bamford up to January 2018 peer-reviewed journals or scholarly books: over 110 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 22; Google scholar h index = 24;
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)