

# **Palaeontological Impact Assessment for the proposed Delmore Park Ext 8 Bulk Services Project, Boksburg, Gauteng Province**

## **Site Visit (Phase 2) Report**

**For**

**Heritage Contracts and Archaeological Consulting**

**09 November 2020**

**Prof Marion Bamford**

Palaeobotanist

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## **Expertise of Specialist**

The Palaeontologist Consultant is: Prof Marion Bamford  
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf  
Experience: 31 years research; 23 years PIA studies

## **Declaration of Independence**

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by HCAC, Modimolle, 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:

A handwritten signature in blue ink, appearing to read 'MKBamford', with a horizontal line underneath it.

## Executive Summary

A palaeontological Impact Assessment was requested for the proposed Delmore Park Ext 8 Bulk Services project. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The site visit was carried out on 29th October by Rick Tolchard (PhD candidate in Palaeontology).

The routes for bulk sewer pipeline are on non-fossiliferous rocks of the Johannesburg Subgroup so that section may proceed, as far as the palaeontology is concerned.

The route for the **bulk water pipeline**:

This route is mostly on Vryheid Formation shales and a short section on Dwyka Group tillites and diamictites. Based on the observations made during the site visit, there are no fossils in the highly disturbed surface soils and sands. It is unlikely that any fossils would be preserved in the top few metres of soil that will be excavated for the trench in which to lay the outfall sewer pipes. Nonetheless, a Fossil Chance Find Protocol should be added to the EMP: if fossils are found once excavations have commenced then they should be rescued, and a palaeontologist called to assess and collect a representative sample.

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# 1. Background

The City of Ekurhuleni proposes to upgrade and realign the Bulk Water Supply System (BWSS) for Delmore Park and Lilianton. The project originates on farms Driefontein 85-IR and Driefontein 87-IR, where it extends from Delmore Park Extension 1, encompasses Delmore Park Extension 2, 7 and 8 until it intersects with Lower Boksburg/ Commissioner Road above Reiger Park Extension.

There are two sections to the project, a bulk sewer pipeline (Figure 1) and a bulk water line (Figure 2). The sewer line will include a new bulk sewer line (Delmore Park Main Branch) and replacement of a section of the existing Lilianton Main Outfall Sewer (Figure 1).

A Palaeontological Impact Assessment was requested for the whole project. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for bulk sewer pipeline and bulk water pipeline, and both are reported herein.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2017)

	<b>A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:</b>	<b>Relevant section in report</b>
ai	Details of the specialist who prepared the report	Appendix
a ii	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
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
h	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

i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j	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
k	Any mitigation measures for inclusion in the EMPr	Appendix A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	N/A
nii	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
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies if any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A

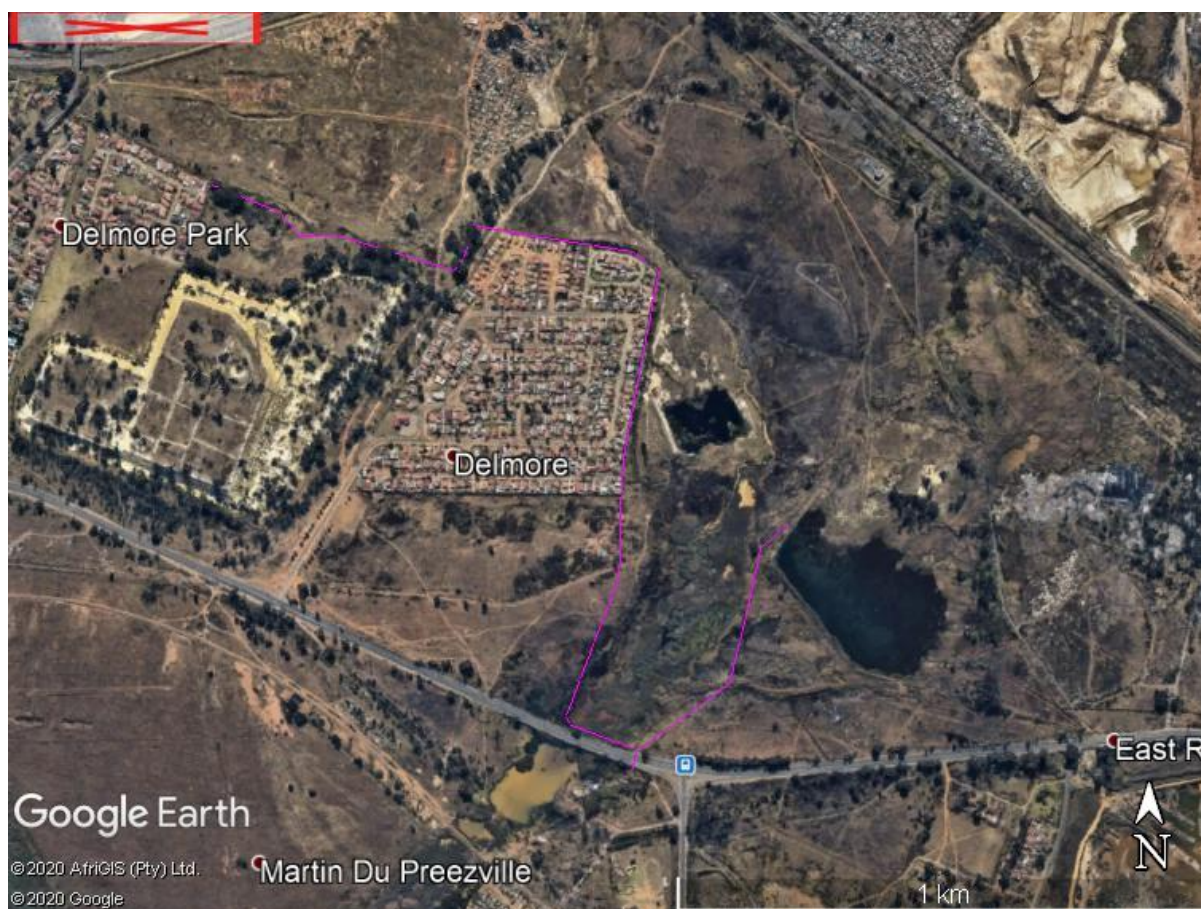


Figure 1: Google Earth map of the proposed bulk sewer pipeline project. The bulk sewer pipeline is indicated by the purple lines. Map supplied by HCAC.

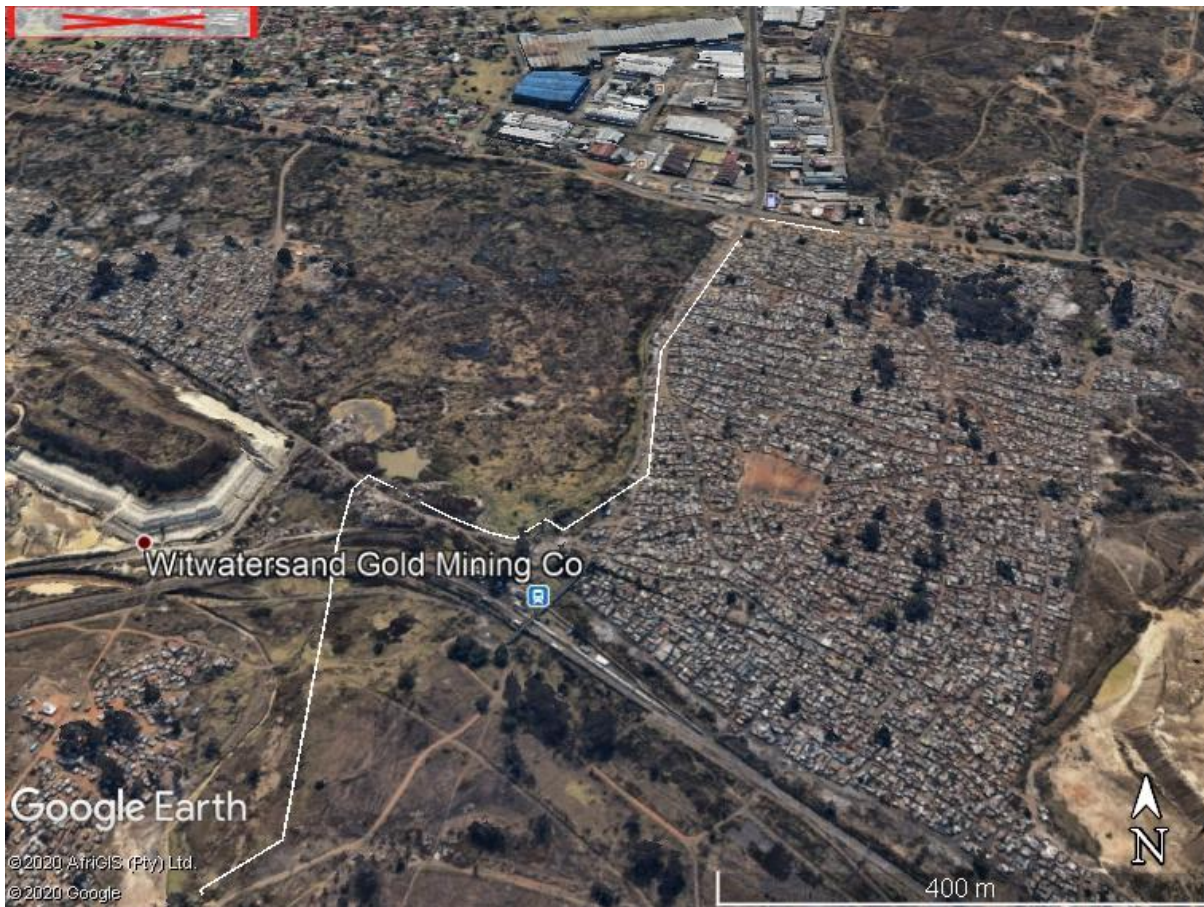


Figure 2: Google Earth map for the bulk water pipeline of the project, indicated by the white lines. Map supplied by HCAC.

## 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 (as reported herein, and collect or rescue fossils if required);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (as indicated in section 4 below); and

4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a just a representative sample collected and housed in a recognised repository.

### 3. Geology and Palaeontology

#### i. Project location and geological context

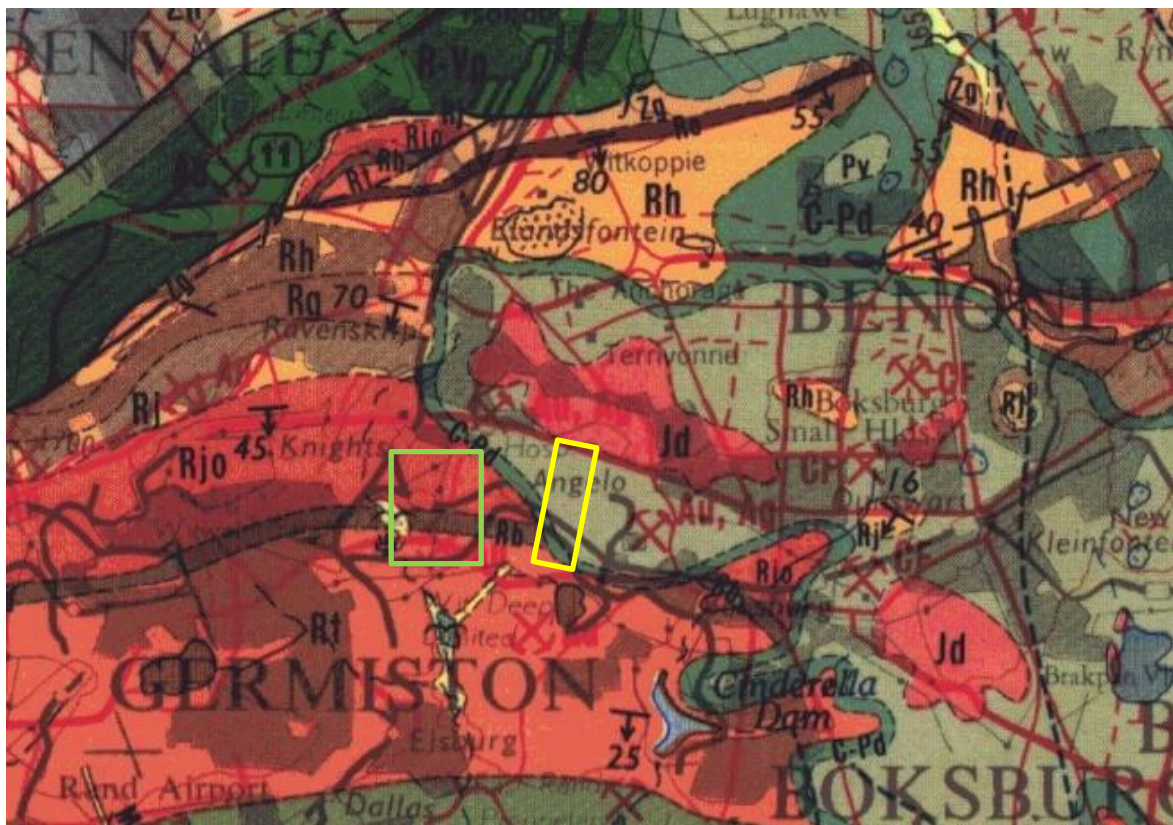


Figure 3: Geological map of the area around Delmore. The Bulk sewer pipeline is within the green outline and bulk water pipeline within the yellow outline. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2628 East Rand.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006. Johnson et al., 2006; McCarthy et al., 2006; Robb et al., 2006; van der Westhuizen et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; green shading = formations impacted by the Delmore Park section and yellow by the Lilianton section of the proposed pipelines.

Symbol	Group/Formation	Lithology	Approximate Age
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pv	Vryheid Fm, Ecca Group, Karoo SG	Shales, sandstone, coal	Lower Permian, Middle Ecca



Symbol	Group/Formation	Lithology	Approximate Age
C-Pd	Dwyka Group, Karoo SG	Diamictites, tillites sandstones and mudstones	Late Carboniferous to Early Permian
Rt	Turfontein Subgroup, Central Rand Group, Witwatersrand SG	Conglomerate, quartzite	Ca 2750 Ma
Rjo	Johannesburg Subgroup, Central Rand Group, Witwatersrand SG	Quartzite, conglomerate, shale	
Rj	Jeppeshtown Subgroup, West Rand Group, Witwatersrand SG	Shale, quartzite, lava	
Rg	Government Subgroup, West Rand Group, Witwatersrand SG	Quartzite, shale	
Rh	Hospital Hill Subgroup, West Rand Group, Witwatersrand SG	Shale quartzite	Ca 2950 Ma

## ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4.

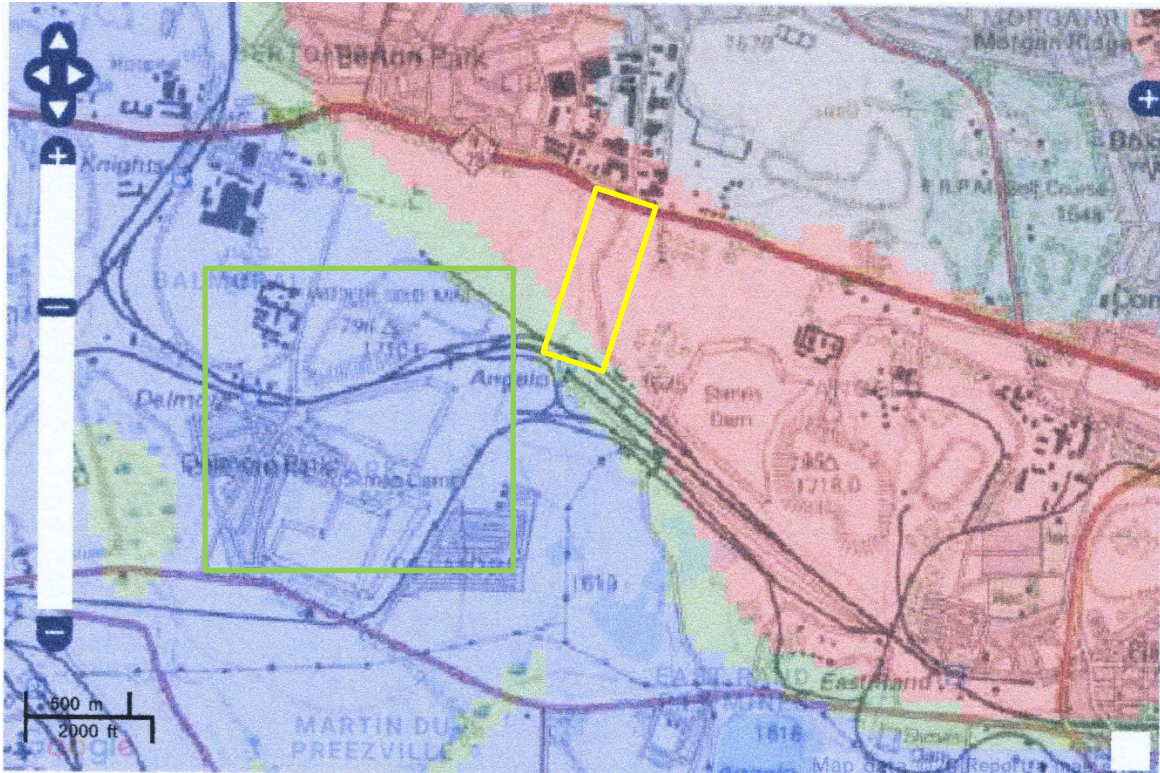


Figure 4: SAHRIS palaeosensitivity map for the site for the proposed BWSS upgrade and realignment. The Bulk Water Pipeline is within the yellow outline and the Bulk Sewer Pipeline within the green outline. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the Bulk Water Pipeline is indicated as very highly sensitive (red) because it lies on the shales of the Vryheid Formation with a short section on the Dwyka Group tillites in the central part (Figure 3) so a site visit was undertaken on 29<sup>th</sup> October. The types of fossils expected are plant impressions of the *Glossopteris* flora (*Glossopteris* leaves, lycopods, sphenophytes, ferns and early gymnosperms).

The Bulk sewer Pipeline are on the quartzites and conglomerates of the Johannesburg Subgroup and are of low sensitivity (blue) so no site visit was necessary.

### lii Site visit observations

The route along Station Road from the R29 (bulk water pipeline) southwards to Angelo Railway Station was extremely disturbed with informal dwellings and spaza shops along the west side, piles of rubbish in the street and unfriendly residents. It was not safe to get out of the vehicle. Photographs taken by R Tolchard.



Figure 5: Station Road looking southwards, close to the intersection with the R29 (Main Reef Road). Both sides of the road are lined with informal structures and it was not possible (or safe) to access the land to the west (right of the photo). Note that the original tarmac of the road surface is mostly missing.



Figure 6: Central section of Station Road, nearly impassable because of the refuse piled along the right hand side. Gum trees on the far right are just north of Angelo Station.



Figure 7: Detail of land alongside the road showing layers of construction, mending etc. No fossils seen because of such disturbance.

#### 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**

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

**TABLE 3B: IMPACT ASSESSMENT**

<b>PART B: ASSESSMENT</b>		
<b>SEVERITY/NATURE</b>	<b>H</b>	-
	<b>M</b>	-
	<b>L</b>	Soils do not preserve plant fossils; so far there are no records from the Vryheid formation of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be very unlikely.
	<b>L+</b>	-
	<b>M+</b>	-
	<b>H+</b>	-
<b>DURATION</b>	<b>L</b>	-
	<b>M</b>	-
	<b>H</b>	Where manifest, the impact will be permanent.
<b>SPATIAL SCALE</b>	<b>L</b>	Since only the possible fossils within the area would be fossil plants from the <i>Glossopteris</i> flora in the shales, the spatial scale will be localised within the site boundary.
	<b>M</b>	-
	<b>H</b>	-
<b>PROBABILITY</b>	<b>H</b>	-
	<b>M</b>	-
	<b>L</b>	It is extremely unlikely that any fossils would be found in the loose soil or sand that will be excavated through to law the pipes. No fossils were seen. Undamaged fossils might occur in the shales below ground, therefore, a Fossil Chance Find protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are

the correct type and age to preserve fossil plants of the *Glossopteris* flora but NO FOSSILS WERE SEEN during the site visit and survey. Since there is an extremely small chance that fossils from the undisturbed and unweathered shales below ground of the Vryheid Formation may be disturbed a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

## 5. Assumptions and uncertainties

Based on the geology of the area and the site visit and survey, there are no fossils or rocky outcrops present along the route for the pipe. Furthermore, the area is extremely disturbed. It can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and do contain fossil plant, insect, invertebrate and vertebrate material. It is not known if fossils are preserved in the shales below ground. The sands of the Quaternary period would not preserve fossils.

## 6. Recommendation

The routes for the **bulk sewer pipeline** are on non-fossiliferous rocks of the Johannesburg Subgroup so that section may proceed, as far as the palaeontology is concerned.

The route for the **bulk water pipeline**:

Based on the observations made during the site visit, there are no fossils in the highly disturbed surface soils and sands. It is unlikely that any fossils would be preserved in the top few metres of soil that will be excavated for the trench in which to lay the outfall sewer pipes. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once excavations have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

## 7. References

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodrum of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

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.

Van der Westhuizen, W.A., de Bruijn, H., Meintjes, P.G., 2006. The Ventersdorp 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 187-208.

## 8. Chance Find Protocol

### **Monitoring Programme for Palaeontology – to commence once the excavations for trenches for the pipes begin.**

1. The following procedure is only required if fossils are seen on the surface and when excavations commence.
2. When excavations begin the rocks must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone, coal) should be put aside in a suitably protected place. This way the mining 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 8). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer/miners then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, 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.
7. If no good fossil material is recovered then no site inspections by the palaeontologist will not be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.



## Appendix A – Examples of fossil plants of the *Glossopteris* Flora from the Vryheid Formation

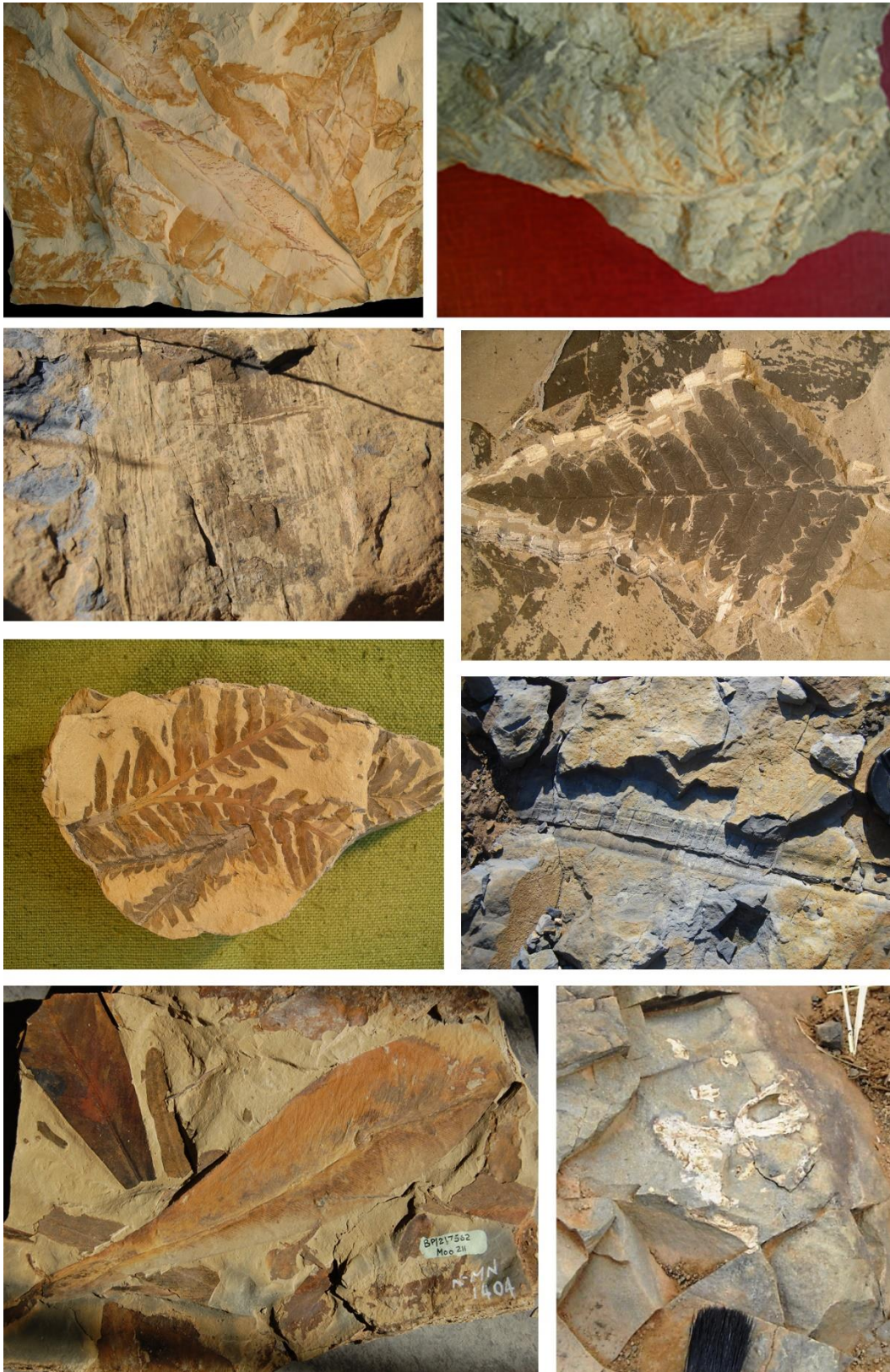


Figure 8: Fossil plant impressions from the *Glossopteris* flora (and bones, bottom right).

## Appendix B – Details of specialists

### Curriculum vitae (short) - Marion Bamford PhD July 2020

#### 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  
Fax : +27 11 717 6694  
Cell : 082 555 6937  
E-mail : [marion.bamford@wits.ac.za](mailto:marion.bamford@wits.ac.za) ; [marionbamford12@gmail.com](mailto: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	9	2
Masters	9	5
PhD	11	5
Postdoctoral fellows	10	4

### **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 – 2020  
*Journal of African Earth Sciences*: 2020 –

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
- 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
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for Enviropro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells

## **xi) Research Output**

Publications by M K Bamford up to December 2019 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 8 book chapters.

Scopus h index = 29; Google scholar h index = 36;

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)

## **Mr Frederick Tolchard**

### **Brief Curriculum Vitae – November 2020**

#### **Academic training**

BA Archaeology – University of the Witwatersrand, graduated 2015  
BSc (Honours) Palaeontology – University of the Witwatersrand, 2017 with distinction  
MSc Palaeontology – University of the Witwatersrand, 2018 – 2019. Graduated 2020 with Distinction  
PhD Palaeontology – Wits – 2020 - current

#### **Field Experience**

Honours Fieldtrip – Karoo biostratigraphy – April 2017  
Research fieldwork – Elliot Formation with Prof Choiniere – April 2018, November 2018; April 2019

#### **Publications**

Tolchard, F., Nesbitt, S.J., Desojo, J.B., Viglietti, P.A., Butler, R.J. and Choiniere, J.N., 2019.  
'Rauisuchian' material from the lower Elliot Formation of South Africa: Implications for late Triassic biogeography and biostratigraphy. *Journal of African Earth Sciences*, 160, 103610.

Viglietti, P.A., McPhee, B.W., Bordy, E.M., Sciscio, L., Barrett, P.M., Benson, R.B.J., Wills, F., Tolchard, F., Choiniere, J.N., 2020. Biostratigraphy of the Scalenodontoides Assemblage Zone (Stormberg Group, Karoo Supergroup), South Africa. *South African Journal of Geology* 123, 239-248.

#### **PIA fieldwork projects**

2018 May – Williston area – SARAO project, Digby Wells  
2018 September – Lichtenburg PVs – CTS Heritage  
2018 November – Nomalanga farming – Digby Wells  
2019 January – Thubelisha coal – Digby Wells  
2019 March – Matla coal – Digby Wells  
2019 March – Musina-Machado SEZ – Digby Wells  
2019 June – Temo coal – Digby Wells  
2019 September – Makapanstad Agripark – Plantago  
2020 January – Hendrina, Kwazamakuhle – Kudzala  
2020 February – Hartebeestpoort Dam - Prescali  
2020 March – Twyfelaar Coal mine – Digby Wells  
2020 March – Ceres Borrow Pits – ACO Associates  
2020 March – Copper Sunset Sand – Digby Wells  
2020 October – Belfast loop and Expansion – Nsovo  
2020 October – VLNR lodge Mapungubwe - HCAC