Palaeontological Impact Assessment for the proposed Taaibosch Puts Energy Cluster, Postmasburg, Northern Cape Province

CTS21_084

Site Visit Report (Phase 2)

For

CTS Heritage

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Expertise of Specialist

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Experience: 33 years research; 25 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by CTS Heritage, Cape Town, 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

A Palaeontological Impact Assessment was requested for the proposed Taaibosch Puts Energy Cluster Facility (SEFs, WEFs, Green Hydrogen Facility and Green Ammonia production facility) to the east of Postmasburg, Northern Cape Province, and overhead power lines to feed into the existing Olien substation northeast of Lime Acres.

To comply with the regulations of 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 site visit (Phase 2) Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed SEF and WEF sites lie on the moderately fossiliferous Quaternary sands but it is unlikely that any fossil traps such as palaeo-pans and paleao-springs occur in the project footprint. The proposed OHL routes to connect the Taaibosch Puts Energy Cluster facility to Olien Substation, the Northern and Southern, lie on potentially fossiliferous Campbell Rand Subgroup dolomites that could preserve trace fossils such as stromatolites. The site visit by palaeontologists on 27-28 February 2022 confirmed that there are **NO FOSSILS of any kind** along these routes. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor/ environmental officer/ other designated responsible person once excavations/drilling/activities for pole foundations have commenced.

The western energy cluster site can be considered as non-fossiliferous. The two eastern OHL routes have no fossils on the surface as confirmed by the site visit. The impact on the palaeontological heritage therefore is very low for the west and low for the eastern routes. As far as the palaeontology is concerned, the project should be authorised.

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i. Background

ENERTRAG South Africa (Pty) Ltd, Reg no. 2017/143710/07 (ESA) has appointed Jones & Wagener (Pty) Ltd Engineering and Environmental Consultants (J&W) to assist with the respective permitting processes, including as relevant a Waste Management License (WML), Air Emissions License (AEL), respective applications for Environmental Authorisation (EA) and Water Use License application/s (WUL) (as required) for the proposed Taaibosch Puts Energy Cluster (collectively comprising the proposed projects). In addition, the applicant will apply as per Section 53 of the Mineral and Petroleum Resources Development Act (No 28 of 2002) for land use contrary to the objectives of the act.

The proposed projects are located approximately 28 km south-west of Danielskuil and 30 km east of Postmasburg in the Tsantsabane Municipality, Northern Cap (Figure 1). The proposed projects collectively comprise approximately 11 110 ha and consist of the following:

- Kora (I – IV) Solar PV Energy Facilities;
- Koraqua (I – V) Solar PV Energy Facilities;
- Khoemana Wind Energy Facility;
- Gorachouqua (I and II) Wind Energy Facilities;
- Korakobab Green Hydrogen Facility;
- Kei Korana Green Ammonia production facility;
- Electrical Grid Infrastructure (EGI) respectively for the proposed projects.

This palaeontology specialist report records the findings of the fieldwork conducted for the proposed Taaibosch Puts Energy Cluster (collectively comprising the proposed projects) but focuses on the EGI powerline routes eastwards to the existing Eskom Olien substation. There are two routes, namely the proposed Overhead line (OHL) alignment – North and the OHL alignment – South (Figure 2). The Energy Cluster is on Quaternary sands that are moderately sensitive and do not require a site visit, while the EGI north and south OHL alignments are partly along very highly sensitive rocks of the Lime Acres Formation (Figures 3, 4)

The Taaibosch Puts Energy Cluster area is split roughly in two sections with the western side dedicated to the proposed solar farms (SEFs) while the eastern side consists of the proposed wind farm (WEFs).

Two powerline routes running for about 30km each along the southern and northern ends that connect up the electrical generation facilities to the Olien Eskom substation east of Lime Acres were assessed. The Asbestos Mountains form a low series of hills running from the southwest to the northeast between Lime Acres and the eastern end of the proposed wind farm.

An existing solar farm (Lesedi Solar Park) lies just to the north of the study area and is similar in scale to the Koraqua solar farm proposed at Springfield 470 farm and the Kora solar farm proposed at Farmersfield 572 farm. The WEF lies on the farms Sunnyside (469), Strathmore (500), Fairview and Klein Fairview (497) and Taaibosch Puts (499).

Taaibosch Puts is the only property which is predominantly flat, uniform and covered in grassland. The rest of the properties have various flat grassland areas in amongst low, gentle ridges and small koppies.

The powerline routes goes along similar ground before linking up with an existing 765kV powerline route along nearly flat calcareous ground extending into the Ghaap Plateau Vaalbosveld, the Olifantshoek Plains Thornveld and Kuruman Mountain Bushveld vegetation types (Mucina and Rutherford, 2009).

A Palaeontological Impact Assessment was requested for the Taaibosch Puts Energy Cluster project. To comply with the regulations of 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 site visit and walkthrough (Phase 2) Palaeontological Impact Assessment (PIA) was completed for the proposed development, focussed on the potentially very highly fossiliferous powerline routes and is reported herein.

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

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
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 i.
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

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
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 ii.
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 viii.
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 vii.
k	Any mitigation measures for inclusion in the EMPr	Section 8, 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	Section 8, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6
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	Sections 6, 8
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

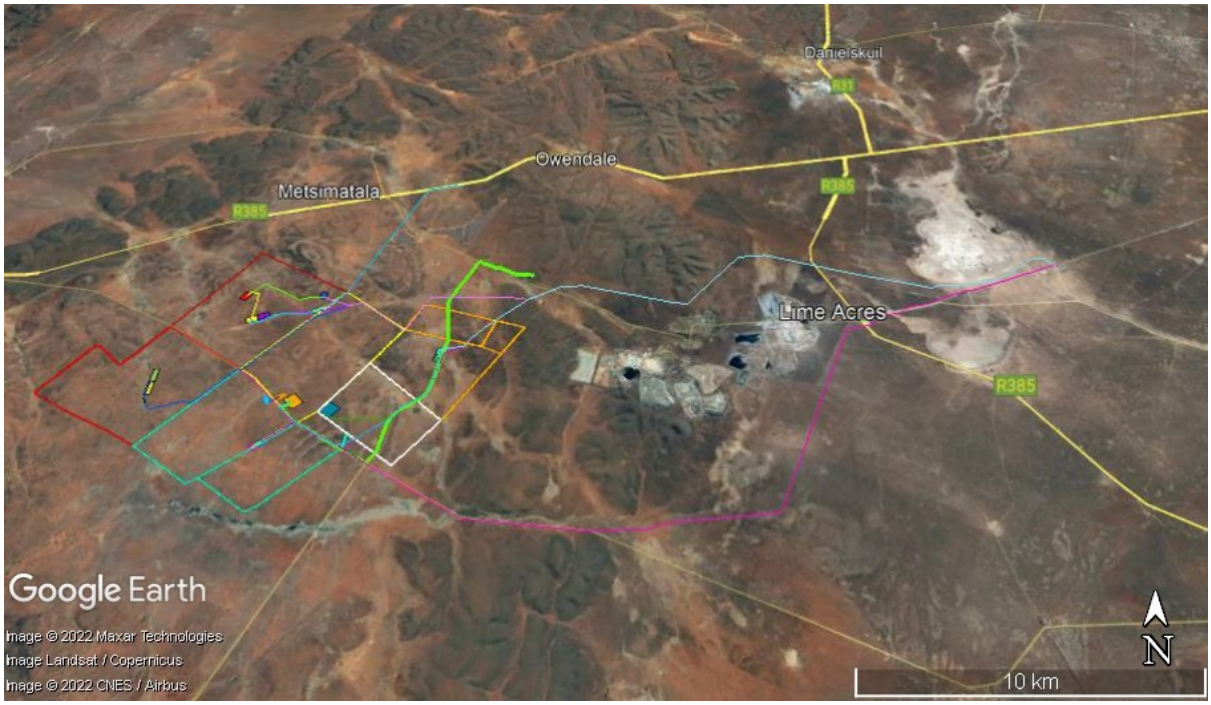

Figure 1: Google Earth map of the proposed development showing the relevant land marks. The SEFs and WEFs will be to the west.

Figure 2: Google Earth map of the eastern powerline routes that fall on very highly sensitive strata showing the Northern OHL route (blue) and Southern OHL route (lilac).

ii. 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 is the case here;
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*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

iii. Geology and Palaeontology

iv. Project location and geological context

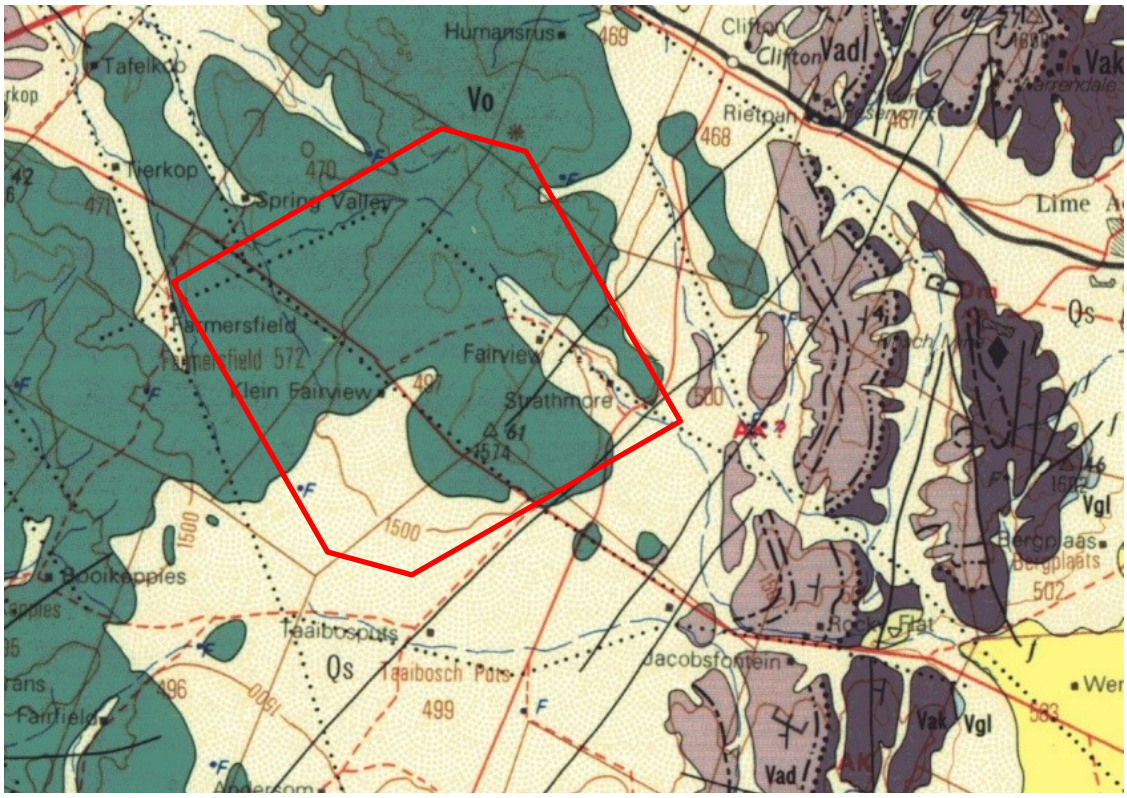

Figure 3: Geological map of the area around the western SEFs and WEFs for the Taaibosch Puts Energy cluster indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2822 Postmasburg.

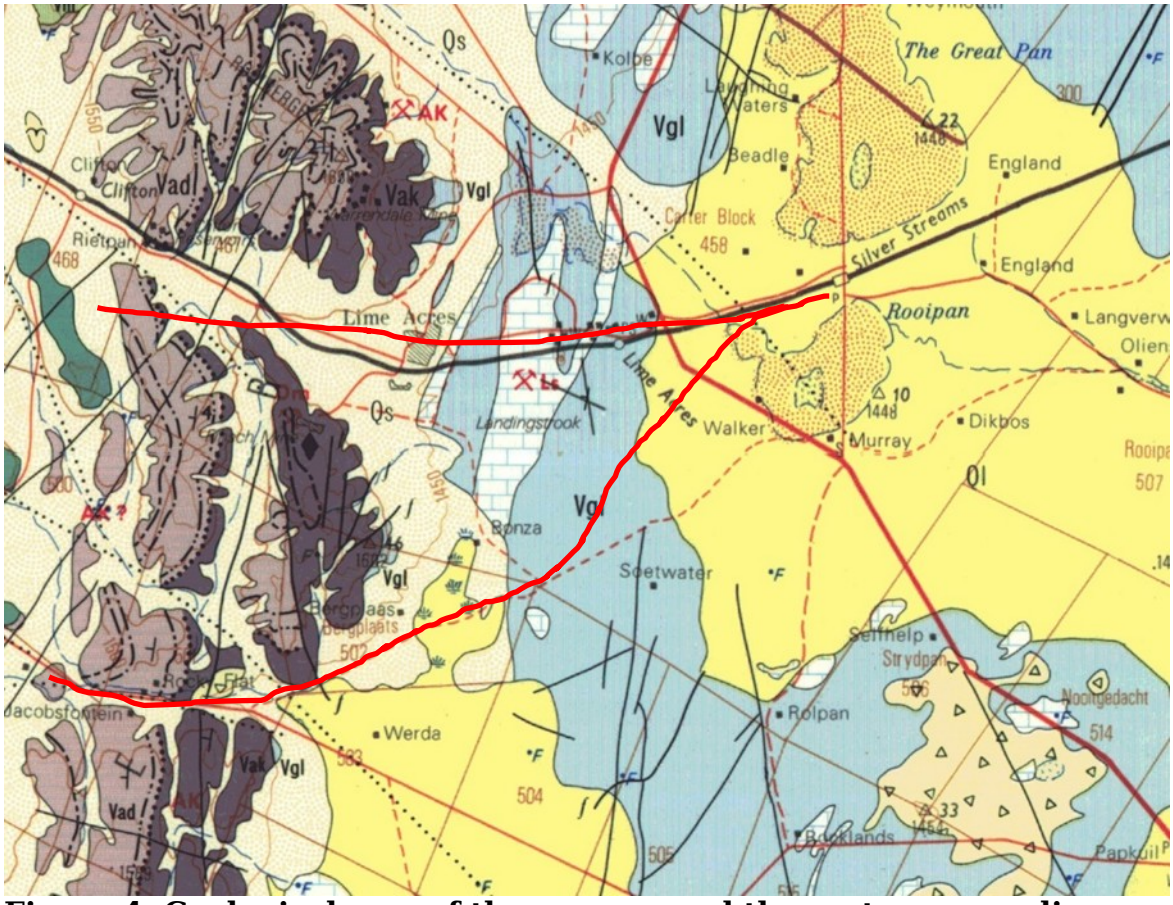

Figure 4: Geological map of the area around the eastern powerline routes the Taaibosch Puts Energy cluster indicated by the red lines. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2822 Postmasburg.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006. Johnson et al., 2006; Schroder et al., 2016). SG = Supergroup; Fm = Formation; Mb = Member; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Quaternary sands	Alluvium, sand, aeolian sand	Neogene, ca 2.5 Ma to present
Ql	Quaternary limestones	Dolerite dykes, intrusive	Tertiary-Quaternary,
Vo	Ongeluk Fm, Postmasburg Group, Transvaal SG	Andesitic lava, amygdaloidal lava	2222 Ma

Symbol	Group/Formation	Lithology	Approximate Age
Vad	Danielskuil Fm, Asbestos Hills Group Subgroup, Ghaap Group, Transvaal SG	Banded ironstone	2460 – 2440 Ma
Vak	Kuruman Fm, Asbestos Hills Group Subgroup, Ghaap Group, Transvaal SG	Banded ironstone	2460 – 2440 Ma
Vgl	Lime Acres Mb, Kogelbeen Fm, Cambell Rand Subgroup, Ghaap Group, Transvaal SG.	Dolomite, limestone	>2521 Ma

The site lies in the Griqualand West Basin that preserves sediments of the Transvaal Supergroup. Overlying these rocks are much younger sands of the Quaternary Kalahari Group (Figures 3, 4).

The Late Archaean to early Proterozoic Transvaal Supergroup is preserved in three structural basins on the Kaapvaal Craton (Eriksson et al., 2006). In South Africa are the Transvaal and Griqualand West Basins, and the Kanye Basin is in southern Botswana. The Griqualand West Basin is divided into the Ghaap Plateau sub-basin and the Prieska sub-basin. Sediments in the lower parts of the basins are very similar but they differ somewhat higher up the sequences. Several tectonic events have greatly deformed the south western portion of the Griqualand West Basin between the two sub-basins

The Transvaal Supergroup comprises one of world's earliest carbonate platform successions (Beukes, 1987; Eriksson et al., 2006; Zeh et al., 2020). In some areas there are well preserved stromatolites that are evidence of the photosynthetic activity of blue green bacteria and green algae. These microbes formed colonies in warm, shallow seas.

The Transvaal Supergroup rocks in the Griqualand West Basin can be correlated with the rocks in the Transvaal Basin, closely according to Beukes and colleagues, or not so closely according to Moore and colleagues. Nonetheless, these rocks represent on a very large scale, a sequence of sediments filling the basins under conditions of lacustrine, fluvial, volcanic and glacial cycles in a tectonically active region. The predominantly carbonaceous sediments are evidence of the increase in the atmosphere of oxygen produced by algal colony photosysnthesis, the so-called Great Oxygen Event (ca 2.40 – 2.32 Ga) and precursor to an environment where diverse life forms could evolve. The Neoarchean-

Paleoproterozoic Transvaal Supergroup in South Africa contains the well-preserved stromatolitic Campbellrand -Malmani carbonate platform (Griqualand West Basin – Transvaal Basin respectively), which was deposited in shallow seawater shortly before the Great Oxidation Event (GOE).

In the Griqualand West sub-basin are the basal Schmidtsdrift Subgroup, Campbell Rand Subgroup and Asbestos Hills Subgroup.

The Campbell Rand Subgroup has been divided into seven formations based on the different environmental settings that produced stromatolites, microbial mats, laminates, chert and carbonate platform.

The Monteville Formation of the Campbell Rand Subgroup in the Ghaap Plateau Sub-basin overlies the Clearwater Formation and is composed of up to 200m thickness of stromatolitic domes, then microbial laminites (laminated stromatolitic carbonate rocks)with fenestrae and carbonate argillites, all with intercalated shales and siltstones (Eriksson et al., 2006). The environment is interpreted as successive transgressive-regressive cycles superimposed on a lower-order shallowing upward cycle as the basin filled stromatolitic carbonates and shales.

Next in the sequence is the Reivilo Formation and is the most extensive component of the Campbell Rand Subgroup. It is up to 900m thick, represents a renewed transgressive phase with the upper Kamden Member BIF-like part; the rest is composed of dolomite with giant stromatolitic domes intercalated with cycles of columnar stromatolites (Eriksson et al., 2006).

The overlying Fairfield Formation represents shallow platform conditions again with the clastic laminated carbonate beds passing upward in unto columnar stromatolites and fenestrated laminates. The next two formations, the Klipfonteinheuwel and Papkuil Formations are also composed of platform carbonates with columnar stromatolites and oolitic beds.

The lower Klippan Formation has small stromatolites that pass upwards to form microbial laminates representing a transgression to deep water facies in a lagoonal setting. The overlying Kogelbeen Formation has varying dolomite, limestone and chert lithologies, then domal to columnar stromatolites, laminates and chert. The limestone-rich **Lime Acres Member** that contains economically important limestone, completes this formation,

Next are the Gamohaan and Tsineng Formations with microbial mats, laminates and chert for the top strata of the Campbell Rand Group.

The Asbestos Hills Subgroup has three formations, the lower Kliphuis formation, the **Kuruman Formation** and the **Danielskuil Formation**.

They are all banded iron formations and have vast economically important reserves,

Above the Asbestos Hills Subgroup is the Postmasburg Group. The Makganyene Formation has diamictites and shales from the moraine of glacial conditions. Disconformably overlying these are the **Ongeluk Formation** basaltic andesitic lavas. According to Cornell et al. (1996) and Schroder et al. (2016) the Ongeluk Formation is equivalent to the lavas of the Hekpoort Formation in the Transvaal Basin.

v. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 5. The western part, the SEF and WEF area are on non-fossiliferous lavas of the Ongeluk Formation and on moderately fossiliferous (green) Quaternary sands and aeolian sands. These materials do no preserve fossils because the form aerobic environments that not conducive to preservation. In addition, windblown (aeolian) sand cannot transport fossils that are large enough to see or to be recognisable. These sands, however, may cover palaeo-pans of palaeo-spring, such features that would be visible in the satellite imagery. No such feature is visible in the project footprint.

The two routes for the OHLs to the east are partly on rocks of the Lime Acres Member (Kogelbeen Formation, Campbell Rand Subgroup). Formations in this subgroup preserve a variety of stromatolites, laminites and microbial mats (Eriksson et al., 2006). Stromatolites are the trace fossils that were formed by colonies of green algae and blue-green algae (Cyanobacteria) that grew in warm, shallow marine settings. These algae were responsible for releasing oxygen via the photosynthetic process where atmospheric carbon dioxide and water, using energy from the sun, are converted into carbon chains and compounds that are the building blocks of all living organisms. The released carbon dioxide initially was taken up by the abundant reducing minerals to form oxides, e.g. iron oxide. Eventually free oxygen was released into the atmosphere and some was converted into ozone by the bombardment of cosmic rays. The ozone is critical for the filtering out of harmful ultraviolet rays.

Stromatolites are the layers upon layers of inorganic materials that were deposited during photosynthesis, namely calcium carbonate, magnesium carbonate, calcium sulphate and magnesium sulphate. These layers can be in the form of flat layers, domes or columns depending on the environment where they grew (Beukes, 1987). Some environments did not form stromatolites, just layers of limestone that later was converted to dolomite. The algae that formed the stromatolites are very rarely preserved, and they are microscopic so they can only be seen from thin sections studies under a petrographic microscope.

Laminites and microbial mats are also trace fossils formed by photosynthesising microbes. They have been variously called Microbialites (sensu Burne and Moore, 1987), or Microbially induced sedimentary structures “MISS” (sensu Noffke et al., 2001) and possibly having a non-biotic origin (Davies et al., 2016). These features are very subtle and hard to recognise.

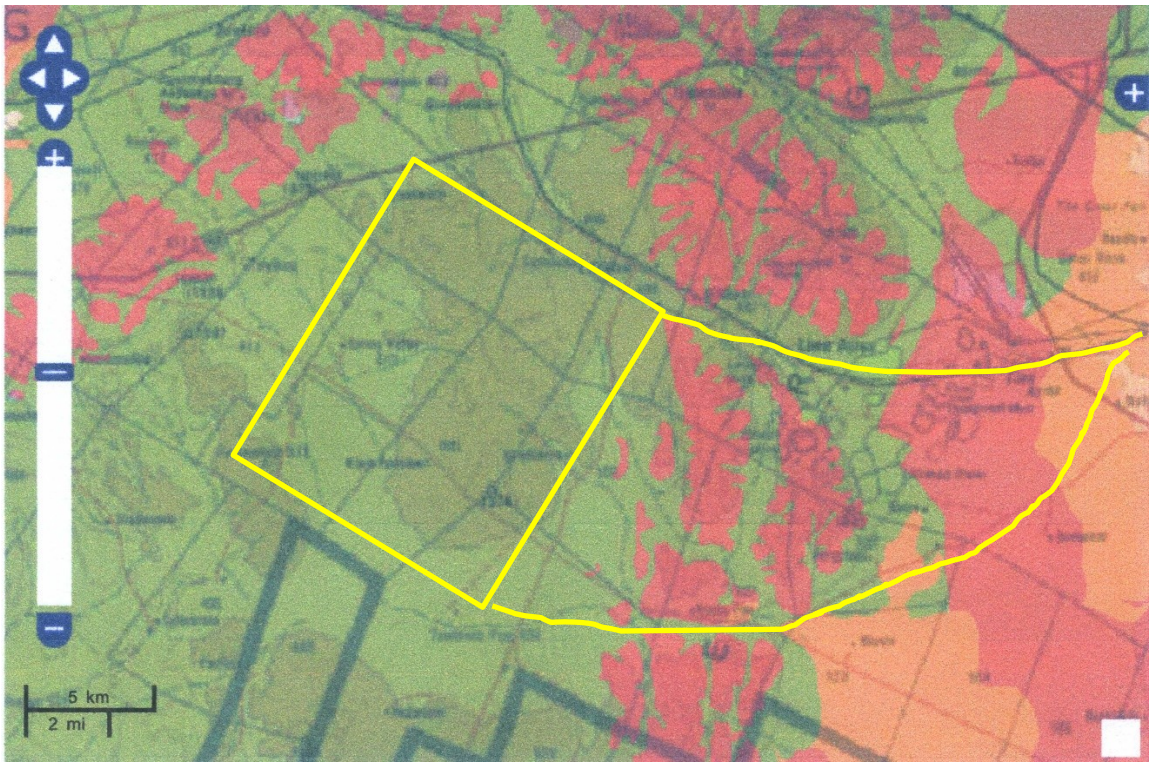

Figure 5: SAHRIS palaeosensitivity map for the site for the proposed Taaibosch Puts Energy Cluster with the SEFs and WEFs within the yellow rectangle (west) and the Northern and Southern OHL routes shown by the lines to the. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the eastern area is indicated as very highly sensitive (red) for the whole of the Ghaap Group although there are different facies in the different formations that make u this group. A site visit was completed on 27-28 February 2022 along the northern and southern OHL routes.

vi. Site visit observations

Table 3: Site observations, and relevant figures. GPS points in separate Exel Spreadsheet

Observations	Figures
North OHL route, west to east: the topography is flat, no rocky outcrops and no dolomite where there could be stromatolites; some carbonaceous outcrops but powdery	6, 8 - d
South OHL route west to east– same as northern route	7, 9a – d
NE route to Olien Substation – same as first part of northern route but less dense grass cover, possibly less gravel than the southern route	6, 10a - d

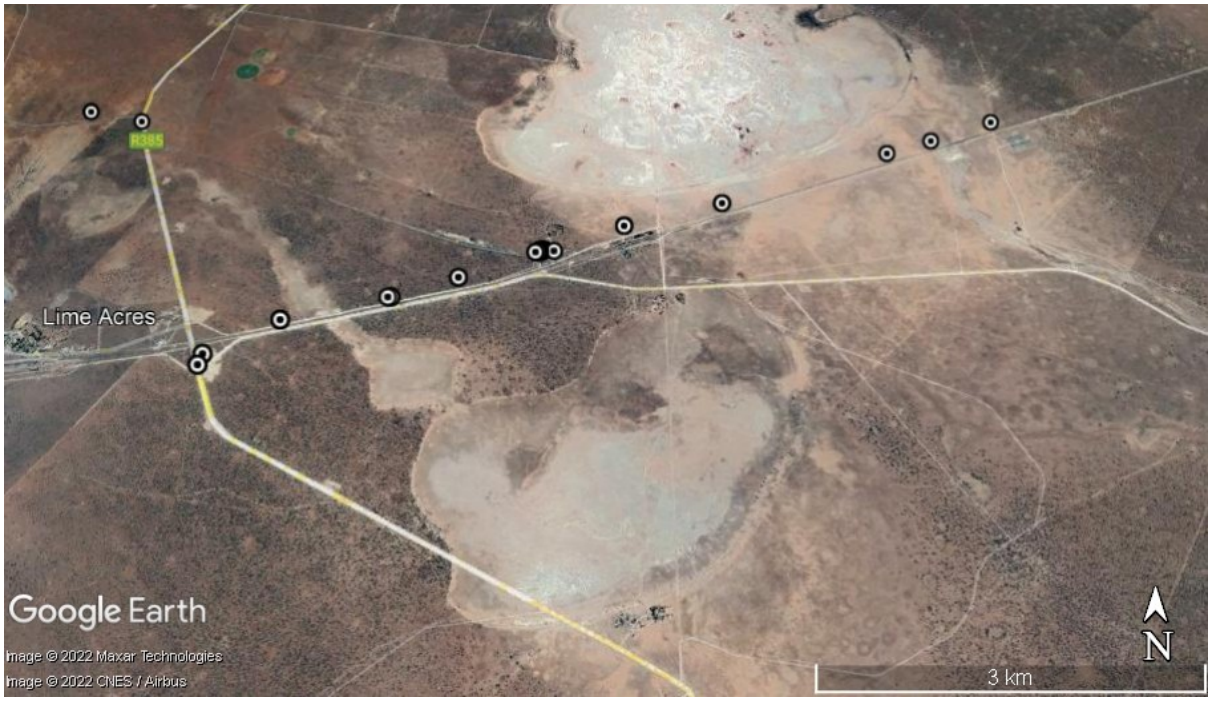

Figure 6: Annotated Google Earth map for the site stops and observations for the Northern OHL route (refer to Table 3 and Figures 8 and 10).

Figure 7: Annotated Google Earth map for the site stops and observations for the Southern OHL route (refer to Table 3 and Figure 9).

Figure 8: Taaibosch Puts Energy Cluster site visit photographs – **Northern OHL** alignment, from west to east. Note the generally flat topography, grasslands with some shrubs in places, sandy soil or carbonaceous soils exposed (B). No exposures of dolomite or any potential outcrops with stromatolites.

Figure 9: Taaibosch Puts Energy Cluster site visit photographs – **Southern OHL alignment** route, from west to east. Note the generally flat topography, grasslands and rare shrubs. Sols is sandy with minor gravel. No dolomite outcrops and no stromatolites.

Figure 10: Taaibosch Puts Energy Cluster site visit photographs – **northeast to Olien Substation** near the railway line. Note the generally flat topography, grasslands and patches of shrubs. Calcrete is visible in some of the roads but may have been brought in make the roads. No exposures of dolomite or any stromatolites anywhere along the route.

vii. Impact assessment

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

Table 4a: 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 4b: Impact Assessment

PART B: Assessment		
SEVERITY/ NATURE	**H**	-
	M	-

PART B: Assessment		
	L	Soils and sands do not preserve plant fossils; so far there are no records from the Lime Acres Fm of stromatolites in this region so it is very unlikely that fossils occur on the site. The impact would be very unlikely.
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	Since the only possible fossils within the area would be trace fossils such as stromatolites in the dolomites, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	It is extremely unlikely that any fossils would be found in the loose sand or soils that will be excavated for pole foundations. **The site visit confirmed that there were no fossils**. Nonetheless, 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 powerline route or Energy Cluster footprint. The geological structures suggest that the rocks are the correct age and type to preserve fossils. The site visit and walk through confirmed that there were NO FOSSILS in the project footprint. Furthermore, the material to be excavated for foundations is soils and sands and these do not preserve fossils. Since there is an extremely small chance that fossils from the Lime Acres Formation below ground 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.

viii. 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 dolomites,

sandstones, shales and sands are typical for the country and only the dolomites might contain trace fossils such as stromatolites. The site visit and walk through on 27-28 February 2022 by palaeontologists Rick Tolchard and Bailey Weiss confirmed that there are NO FOSSILS along the proposed powerline routes from the northeast corner of the Taaibosch Puts Energy Cluster eastwards towards Lime Acres or along the southern route. The Energy cluster footprint is on non-fossiliferous rocks except for the northeast corner. Although this property was not accessible, from road it was possible to see that it had the same vegetation and topography as the first section of the northern powerline route, therefore it can be assumed that the geology is the same and no dolomite was visible. The sands of the Quaternary period would not preserve fossils.

ix. Recommendation

Based on the fossil record but confirmed by the site visit and walk through there are NO FOSSILS such as stromatolites in the Lime Acres Formation (Campbell Rand Group, Ghaap Plateau, Transvaal Supergroup even though fossils have been recorded from rocks of a similar age and type in South Africa. It is extremely unlikely that any fossils would be preserved in the overlying soils and sands of the Quaternary. There is a very small chance that fossils may occur in below the ground surface in the dolomites so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations and drilling have commenced, then they should be rescued and a palaeontologist called to assess and collect a representative sample.

x. References

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xi. Chance Find Protocol

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

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, fossils of plants, insects, bone or coalified material) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossil plants, vertebrates, invertebrates or trace fossils in the shales and mudstones (for example see Figure 11). 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 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 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.

xii. Appendix A – Examples of trace fossils from the Transvaal Supergoup.

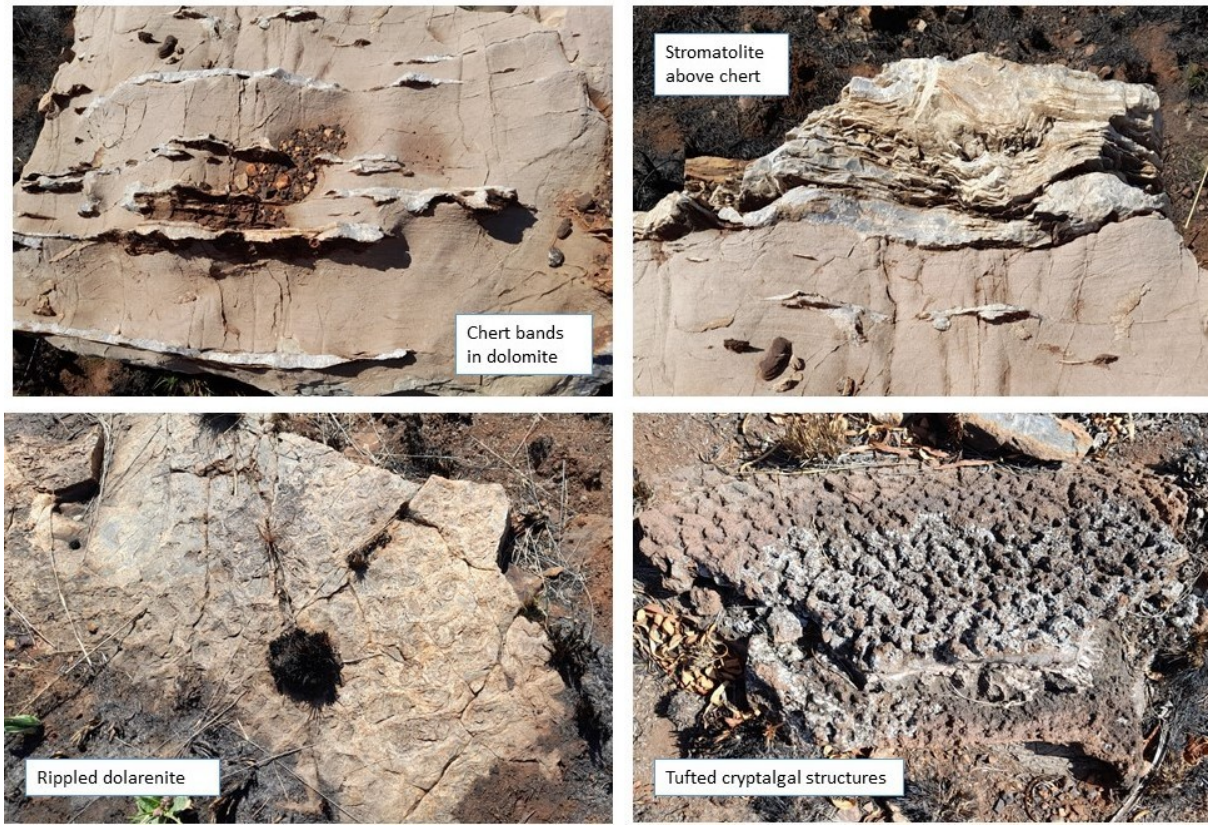

Figure 11: Photographs of different types of stromolitic structures in dolomite (from the Malmani Subgroup).

xiii. Appendix B – Details of specialists

Marion Bamford (PhD)

Short CV for PIAs – Jan 2022

I) **Personal details**

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 ; 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	11	0
Masters	12	4
PhD	11	4
Postdoctoral fellows	12	2

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 12 - 20 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 –
Associate Editor: Cretaceous Research: 2018-2020
Associate Editor: Royal Society Open: 2021 -
Review of manuscripts for ISI-listed journals: 25 local and international journals

x) **Palaeontological Impact Assessments**
Selected from recent project only – list not complete:
- 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
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for Enviropro
- Frankfort-Windfield Eskom Powerline 2020 for 1World
- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage
- Smithfield-Rouxville-Zastron PL 2021 for TheroServe
- Glosam Mine 2021 for AHSA

Xi) **Research Output**
Publications by M K Bamford up to January 2022 peer-reviewed journals or scholarly books: over 160 articles published; 5 submitted/in press; 10 book chapters.
Scopus h-index = 30; Google Scholar h-index = 36; -i10-index = 95
Conferences: numerous presentations at local and international conferences.

Mr Frederick Tolchard
Brief Curriculum Vitae – January 2022

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, Nov 2018; April 2019; Sept 2021

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.

Tolchard F., Kammerer C., Butler R.J., Abdala F., Hendrickx C., Benoit J., Choinière J.N. (2021.) A very large new trirachodontid from the Triassic of South Africa and its implications for Gondwanan biostratigraphy. Journal of Vertebrate Paleontology. DOI: 10.1080/02724634.2021.1929265.

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
2020 November – Delmore Park BWSS - HCAC
2020 December – Kromdraai commercial – HCAC
2021 January – Welgedacht Siding – Elemental Sustainability
2021 March – Shango Kroonstad – Digby Wells
2021 May – Copper Sunset sand mining – Digby Wells
2021 August – New Largo Pit – Golder
2021 August – Khutsong Ext 8 housing, Carletonville, for Afzelia
2021 September – Lichtenburg PV facility – CTS Heritage
2021 October – Ogies South MR – beyondgreen
2021 October – Nooitgedacht Colliery MR – Shangoni
2022 January – Sigma PVs Sasolburg – CTS Heritage

Bailey M. Weiss CV

January 2022

I am currently enrolled as an MSc student, at the University of the Free State (UFS), completing a research project entitled: *Bone microanatomy of Anomodontia (Synapsida: Therapsida) from the Karoo Basin of South Africa*. This project is supervised by Dr Jennifer Botha (National Museum, Bloemfontein) and Co-Supervised by Dr Alexandra Houssaye (Muséum national d'Histoire naturelle, Paris). I completed my BSc honours degree in which I completed a research project entitled: *Limb bone histology of theropod dinosaurs from the Early Jurassic of South Africa*. This project was supervised by Dr Jennifer Botha. I majored in Genetics and Zoology for my BSc degree. I have worked as an Osteohistology Technician at the National Museum, Bloemfontein, as well as a Laboratory Assistant at the UFS. I have been on two Palaeontological field trips one with the National

Museum in the Balfour and Katberg Formations. The other with the University of the Witwatersrand in the Lower Elliot Formation of South Africa.

Qualifications

BSc – Majors: Genetics and Geology - University of the Free State – 2018
BSc Honours – Palaeontology – University of the Free State – 2019
MSc – Palaeontology – University of the Free State – registered 2020, in progress.

PIA fieldwork Experience

July 2021 – Sannaspos PV Facility, Free State for CTS Heritage
October 2021 – Beatrix Mine-Theunissen Eskom powerline for 1World

References:

Dr Jennifer Botha, Head of Palaeontology, National Museum, Bloemfontein
jbotha@nasmus.ac.za

Prof Jonah Choiniere, Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg
Jonah.choiniere@wits.ac.za
