PHASE 1 PALAEONTOLOGICAL ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF A WATER SUPPLY SCHEME FOR MATATIELE WARDS 5&7, ALFRED NZO DISTRICT MUNICIPALITY, EASTERN CAPE PROVINCE

For:

HIA CONSULTANTS

DATE: 23 SEPTEMBER 2014

By

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EXECUTIVE SUMMARY

PSG Heritage was appointed by Beacon Consulting Engineers on behalf of the Alfred Nzo District Municipality to undertake a Phase 1 Palaeontological Impact Assessment, assessing the potential palaeontological impact of the proposed Matatiele Ward 5 and 7, Water Supply Scheme, Alfred Nzo District Municipality in the Eastern Cape. The purpose of this Palaeontological Impact Assessment is to identify exposed and potential palaeontological heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated.

This report forms part of the Basic Environmental Impact Assessment for the proposed Matatiele Ward 5 and 7, Water Supply Scheme, and complies with the requirements for the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Palaeontological Impact Assessment is required to assess any potential impacts to palaeontological heritage within the development footprint of the proposed Matatiele Ward 5 and 7, Water Supply Scheme.

The proposed project entails the construction of a regional water supply scheme in Wards 5 and 7 at Matatiele in the Eastern Cape. The project comprises the establishment of a borehole water supply from six existing boreholes and the construction of a weir, primary bulk main pipeline (±20km), secondary bulk main pipeline (±50km), two command reservoirs and 17 village storage reservoirs.

- The study area where the pipelines are proposed is underlain by rocks of the Triassic aged Tarkastad Subgroup of the Beaufort Group, Karoo Supergroup as well as two prominent sills of Jurassic aged dolerite.
- The Triassic Tarkastad Subgroup is associated with the *Lystrosaurus* and *Cynognathus* Assemblage zones. This group of rock represent an important sedimentological and tectonic event in the geological history of the Karoo Supergroup with major deposition of sandstone with associated vertebrate fossils as well as well-defined casts of vertebrate burrows.

Dr Gideon Groenewald, an experienced fieldworker, visited the site of the proposed water supply scheme on Thursday 18 and Friday 19 September 2014. The topography of the area is rugged, with high mountains and deep valleys. The site of the proposed development is however mostly confined to the valley floor with an associated gentle topography.

- The study area is mostly underlain by deep soils and/or deeply weathered mudstone of the Burgersdorp Formation and dolerite. Only a few outcrops are associated with road cuttings in areas with more rugged topography.

The development site for the proposed Matatiele Ward 5 and 7, Water Supply Scheme, Alfred Nzo District Municipality in the Eastern Cape is underlain by Triassic aged, predominantly mudstone rich, Tarkastad Subgroup sediments that is, in most areas, covered in a relatively deep soil, with few outcrops along road cuttings.

Due to the lack of outcrops and the fact that most of the excavations for the pipelines will be in either deep soil or partly weathered mudstone of the Burgersdorp Formation, a Low Palaeontological sensitivity is allocated to a large part of the development site. If unweathered mudstone bedrock is exposed during the excavation of trenches, or during the excavation for larger infrastructure such as pumping houses and reservoirs, the Palaeontological sensitivity will increase to a High Palaeontological sensitivity and the ECO of the project must be notified. If fossils are observed, the palaeontologist must be informed and the fossils recovered according to SAHRA specifications.

No “no-go” options are discussed as the palaeontological significance would not be affected much by a change in the route in this area. The currently proposed route also passes over areas with deep soils meaning that minimal impact is expected. If fossils are discovered, this may have an operational impact due to a palaeontologist needing to inspect the site to rescue any impacted fossil material according to SAHRA specifications and the associated costs and time implications associated with this action.

It is recommended that:

- The EAP and ECO be informed of the fact that a Low Palaeontological sensitivity is allocated on the ground of deep soil cover in the development area. If fresh bedrock is exposed, the possibility of finding fossils is high and any fossils observed must be reported and rescued by a qualified palaeontologist.
- A qualified Palaeontologist must be on site during excavations into fresh bedrock of the Burgersdorp Formation where a Moderate Palaeontological sensitivity is allocated to the site or where the Palaeontological sensitivity allocation increases to a High Palaeontological sensitivity when fresh bedrock is exposed during construction.

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1. INTRODUCTION

PSG Heritage was appointed by Beacon Consulting Engineers on behalf of the Alfred Nzo District Municipality to undertake a Phase 1 Palaeontological Impact Assessment, assessing the potential palaeontological impact of the proposed Matatiele Ward 5 and 7, Water Supply Scheme, Alfred Nzo District Municipality in the Eastern Cape. The purpose of this Palaeontological Impact Assessment is to identify exposed and potential palaeontological heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated.

1.1. Legal Requirements

This report forms part of the Basic Environmental Impact Assessment for the proposed Matatiele Ward 5 and 7, Water Supply Scheme, and complies with the requirements for the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Palaeontological Impact Assessment is required to assess any potential impacts to palaeontological heritage within the development footprint of the proposed Matatiele Ward 5 and 7, Water Supply Scheme.

Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens; and
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

2. AIMS AND METHODOLOGY

A Phase 1 investigation is often the last opportunity to record the fossil heritage within the development footprint. These records are very important to understand the past and form an important part of South Africa's National Estate.

Following the "SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports" the aims of the palaeontological impact assessment were:

- to identifying exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assessing the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

Prior to the field investigation a preliminary assessment (desktop study) of the topography and geology of the study area was made using appropriate 1:250 000 geological maps (3028 Kokstad) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc) were identified within the study area and the known fossil heritage within each rock unit was inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

Priority palaeontological areas were identified within the development footprint to focus the field investigator's time and resources. The aim of the fieldwork was to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

The likely impact of the proposed development on local fossil heritage was determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the minimal extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 2.1 below.

Table 2.1 Palaeontological sensitivity analysis outcome classification

Sensitivity	Description
Low Sensitivity	Areas where there is likely to be a negligible impact on the fossil heritage. This category is reserved largely for areas underlain by igneous rocks. However, development in fossil bearing strata with shallow excavations or with deep soils or weathered bedrock can also form part of this category.
Moderate Sensitivity	Areas where fossil bearing rock units are present but fossil finds are localised or within thin or scattered sub-units. Pending the nature and scale of the proposed development the chances of finding fossils are moderate. The developer should be made aware of the potential for finding fossils. If fossil material is later discovered it must be appropriately protected and the discovery reported to the appropriate Heritage Authority so that any appropriate mitigation by a palaeontological specialist can be considered and implemented, at the developer's expense.
High Sensitivity	Areas where fossil bearing rock units are present with a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in outcrops and exposed bedrock. The chances of finding fossils during excavations by a professional palaeontologist are high. Palaeontological mitigation measures need to be incorporated into the Environmental Management Plan. The mitigation should involve the comprehensive recording and collection of surface and embedded fossils along and close to the development footprint by a professional palaeontologist.

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, palaeontological mitigation measures should be incorporated into the Environmental Management Plan.

2.1. Scope and Limitations of the Phase 1 Investigation

The scope of a phase 1 Investigation includes:

- an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units;
- a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports;
- data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged) and
- where feasible, location and examination of any fossil collections from the study area (e.g. museums).
- do an on-site investigation to assess the identified palaeontological sensitive areas within the development footprint/study area rather than formal palaeontological collection. The investigation should focus on the sites where bedrock excavations would definitely require palaeontological monitoring.

The results of the field investigation are then used to predict the potential of buried fossil heritage within the development footprint. In some investigations this involves the examination of similar

accessible bedrock exposures, such as road cuttings and quarries, along roads that run parallel to or across the development footprint.

3. PROPOSED DEVELOPMENT DESCRIPTION

The proposed project entails the construction of a regional water supply scheme in Wards 5 and 7 at Matatiele in the Eastern Cape. The project comprises the establishment of a borehole water supply from six existing boreholes and the construction of a weir, primary bulk main pipeline (±20km), secondary bulk main pipeline (±50km), two command reservoirs and 17 village storage reservoirs.

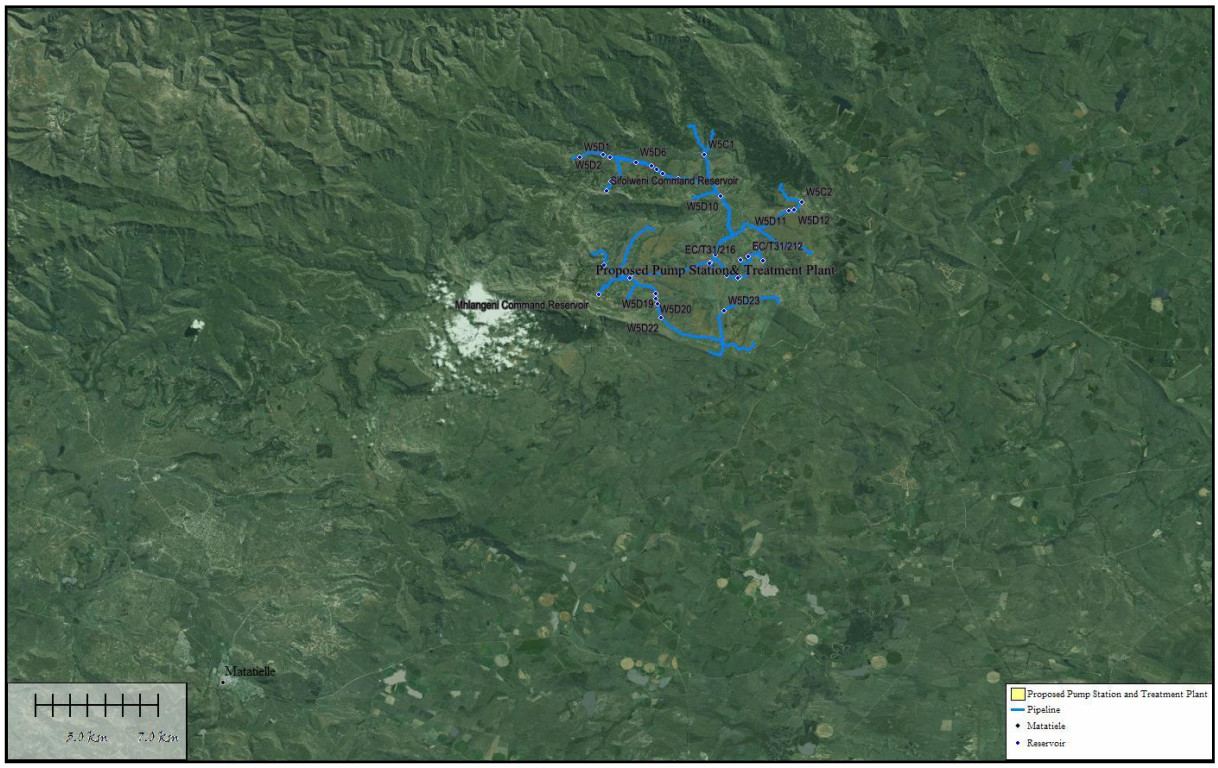

Figure 3.1 Locality and layout of the Proposed Water Supply Scheme

4. GEOLOGY OF THE AREA

The study area where the pipelines are proposed is underlain by rocks of the Triassic aged Tarkastad Subgroup of the Beaufort Group, Karoo Supergroup as well as two prominent sills of Jurassic aged Dolerite (Figure 4.1).

4.1. Tarkastad Subgroup (Trt)

The Tarkastad Subgroup consists of a lower Katberg and upper Burgersdorp Formation. The Katberg Formation is a predominantly arenaceous unit, interpreted as a braided fluvial deposit. The Burgersdorp Formation is predominantly argillaceous, interpreted as a meandering fluvial to lacustrine deposit (Johnson et al, 2006; Groenewald, 1996). The two formations were however not mapped out as individual units on the 1:250 000 map and most of the study area is underlain by the Burgersdorp Formation.

4.2. Dolerite (Jd)

Dolerite sills are present in the central part of the study area and represent magma intrusions into the Karoo Supergroup sediments during the Jurassic volcanic episode that during occurred the breakup of Gondwanaland.

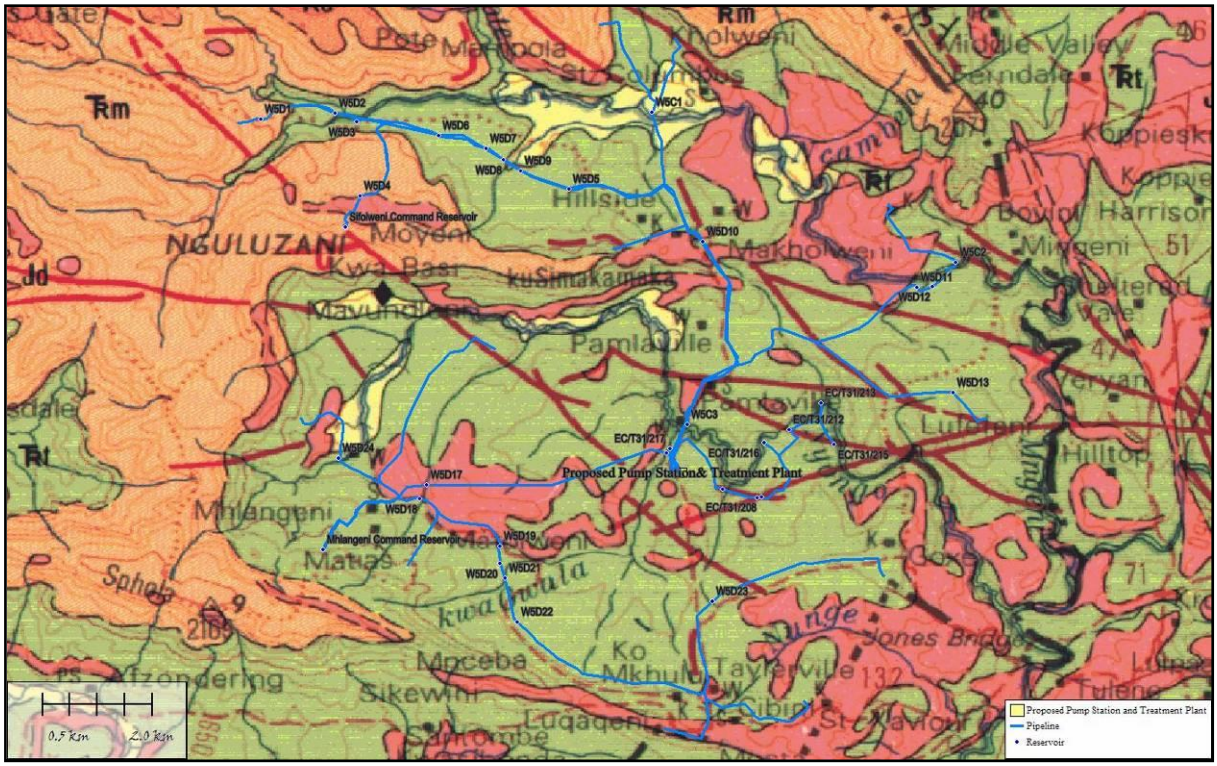

Figure 4.1 Geology of the study area. Trt – Tarkastad Subgroup. Trm – Molteno Formation. Jd - Dolerite

5. PALAEONTOLOGY OF THE AREA

The potential palaeontology of a rock unit relates directly to the geology of the area. The desktop survey includes the comparison of relevant referenced geological maps and locality maps and/or waypoints provided for the development project.
2006).

5.1. Tarkastad Subgroup (Trt)

The Triassic Tarkastad Subgroup is associated with the *Lystrosaurus* and *Cynognathus* Assemblage zones. This group of rock represent an important sedimentological and tectonic event in the geological history of the Karoo Supergroup with major deposition of sandstone with associated vertebrate fossils as well as well-defined casts of vertebrate burrows (Groenewald, 1991; Groenewald, 1996; Rubidge, ed, 1995).

5.2. Karoo Dolerite (Jd)

Due to the igneous character of these rocks they do not contain fossils.

6. PRELIMINARY ASSESSMENT RESULTS

The palaeontological sensitivity was predicted after identifying potentially fossiliferous rock units; ascertaining the fossil heritage from the literature and evaluating the nature and scale of the development itself. The palaeontological sensitivity can be described as significant due to the potential abundance of Triassic aged fossils including remains of, therapsids known to occur within the Tarkastad Subgroup.

7. FIELD INVESTIGATION

Dr Gideon Groenewald, an experienced fieldworker, visited the site of the proposed water supply scheme on Thursday 18 and Friday 19 September 2014. The topography of the area is rugged, with high mountains and deep valleys. The site of the proposed development is however mostly confined to the valley floor with an associated gentle topography.

The study area is mostly underlain by deep soils and/or deeply weathered mudstone of the Burgersdorp Formation and dolerite. Only a few outcrops are associated with road cuttings in areas with more rugged topography.

Figure 7.1 Deep soils with no outcrop (GPS 30 10 2.2S; 29 04 47.2E)

Figure 7.2 Soil cover on Burgersdorp Formation, no outcrops (GPS 30 10 8.3S; 29 03 56.7E.

Figure 7.3 Most of the planned routes of the pipeline have no outcrop (GPS 30 05 35.2S; 29 03 45.0E)

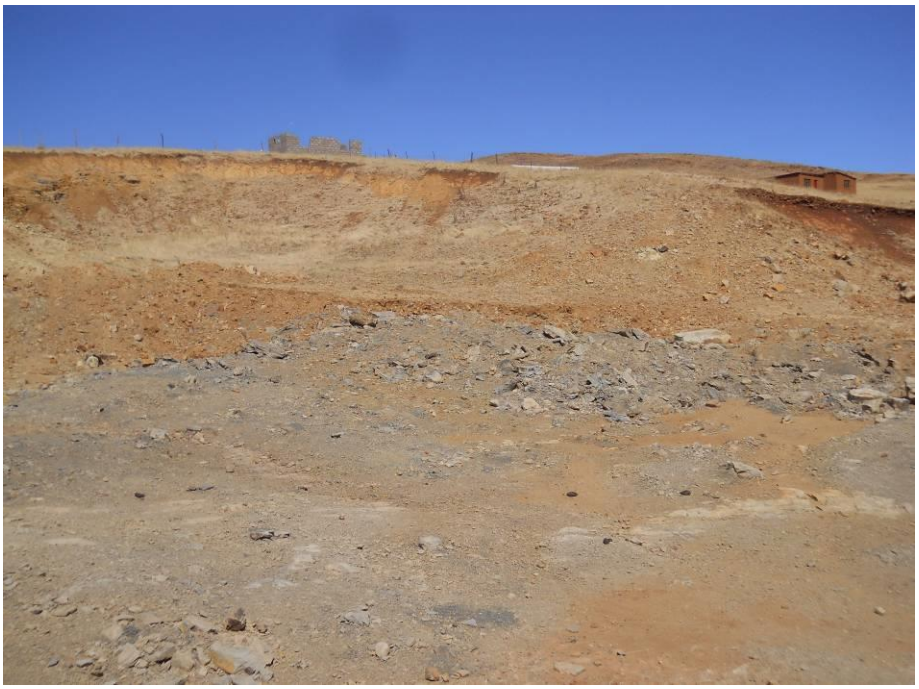

Figure 7.4 Typical quarry, exposing Burgersdorp Formation sediments below dolerite. No fossils observed.

Figure 7.5 General landscape with no outcrop of Burgersdorp Formation (GPS 30 05 1.9S; 29 02 41.0E)

Figure 7.6 Northwestern section underlain by deep soils on Burgersdorp Formation and dolerite. No outcrops

Figure 7.7 Deep soils on dolerite (GPS 30 04 42.8S; 29 03 13.7E)

Figure 7.8 Outcrop of Burgersdorp Formation mudstone. No fossils observed. GPS (30 05 49.4S; 29 03 45.7E)

Figure 7.9 Partly weathered mudstone of the Burgersdorp Formation. No fossils observed. (GPS 30 05 59.3S; 29 03 53.3E)

Figure 7.10 Exposure of Burgersdorp Formation mudstone. No fossils observed. GPS 30 05 59.3S; 29 03 53.3E)

Figure 7.11 Typical deep soil cover on weathered Burgersdorp Formation mudstone, no fossils observed.

Figure 7.12 The southwestern section of the area is also underlain by relatively deep soils on Burgersdorp Formation mudstone and dolerite (GPS 30 08 18.9S; 29 01 19.2E)

Figure 7.13 Most of the excavation for the pipeline will be into deep soils along the access roads (GPS 30 09 49.5S; 29 02 30.6E)

Figure 7.14 The southwestern section is also underlain by relatively deep soils where excavation for the pipelines will follow the access roads with very few outcrops of Burgersdorp Formation mudstone and no fossils were observed. (GPS 30 07 58.3S; 29 00 30.9E)

8. PALAEONTOLOGICAL SIGNIFICANCE AND RATING

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews as well as information gathered during the field investigation.

The palaeontological significance and rating is summarised in Table 8.1 and 8.2 and the Palaeontological sensitivity is shown in Figure 8.1. The methodology for assessing the significance of impacts is based on the methodology as found in Appendix A.

Table 8.1 Palaeontological Significance of Geological Units on Site

Geological Unit	Rock Type and Age	Fossil Heritage	Vertebrate Biozone	Palaeontological Sensitivity
Tarkastad Subgroup	Fluvial and lacustrine mudstone and sandstones. *EARLY TRIASSIC*	Vertebrate fossils from the *Cynognathus* assemblage zones.	*Cynognathus* Assemblage Zone	Moderate sensitivity due to lack of outcrops

Table 8.2 Significance Rating Table

Rock Unit	Overall nature	*Spatial extent Over which impact may be experienced	Duration of impact	Probability of occurrence	Mitigation Potential	Significance of impact (Initial)
Tarkastad Subgroup	Negative	International	Permanent	Possible	High	Slight

*While the fossils will only be impacted on at the site itself, the discovery and rescue or destruction of fossils are of international significance and the impact would thus be of international importance.

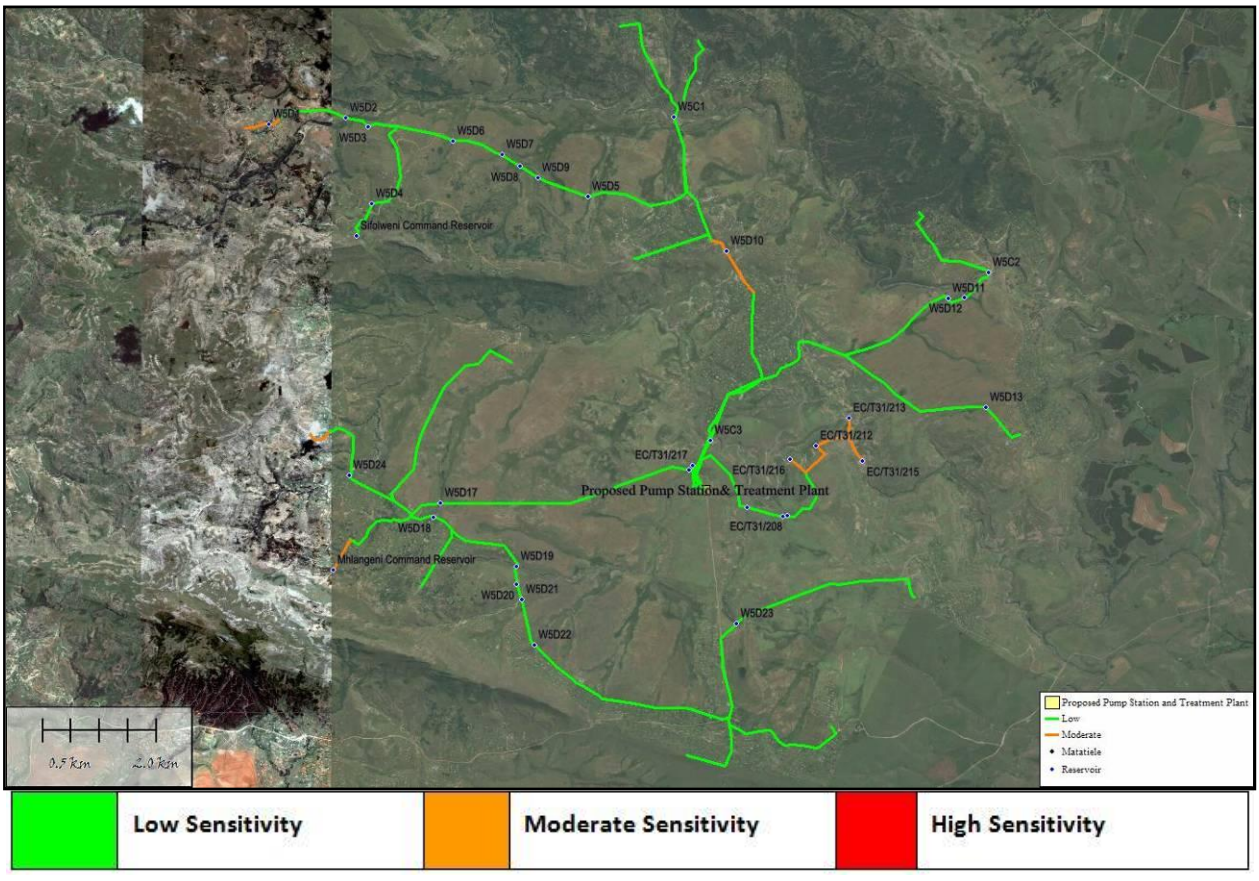

Figure 8.1 Palaeontological sensitivity of the proposed project

9. PALAEONTOLOGICAL IMPACT AND MITIGATION

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews as well as information gathered during the field investigation. The field investigation confirms that the area is underlain by mudstone of the Tarkastad Subgroup.

The Tarkastad Subgroup consists of a lower sandstone-rich Katberg and overlying Burgersdorp Formation and the study area is mainly underlain by mudstone of the Burgersdorp Formation. There are very few outcrops and most of the development area is covered in relatively deep soils.

Due to the fact that most of the excavations for this development will be into the deep soils on site, the larger part of the study area is allocated a Low Palaeontological Significance. In small areas where the excavations will cut into bedrock, a Moderate Palaeontological sensitivity must apply. No fossils have however been observed during the field investigation and the overall impact on Palaeontological Heritage can be regarded as Low.

No “no-go” options are discussed as the palaeontological significance would not be affected much by a change in the route in this area. The currently proposed route also passes over areas with deep soils meaning that minimal impact is expected. If fossils are discovered, this may have an operational impact due to a palaeontologist needing to inspect the site to rescue any impacted fossil material according to SAHRA specifications and the associated costs and time implications associated with this action.

10. CONCLUSION

The development site for the proposed Matatiele Ward 5 and 7, Water Supply Scheme, Alfred Nzo District Municipality in the Eastern Cape is underlain by Triassic aged, predominantly mudstone rich, Tarkastad Subgroup sediments that is in most area covered in a relatively deep soil, with few outcrops along road cuttings.

Due to the lack of outcrops and the fact that most of the excavations for the pipelines will be in either deep soil or partly weathered mudstone of the Burgersdorp Formation, a Low Palaeontological sensitivity is allocated to a large part of the development site. If unweathered mudstone bedrock is exposed during the excavation of trenches, or during the excavation for larger infrastructure such as pumping houses and reservoirs, the Palaeontological sensitivity will increase to a High Palaeontological sensitivity and the ECO of the project must be notified. If fossils are observed, the palaeontologist must be informed and the fossils recovered according to SAHRA specifications.

It is recommended that:

- The EAP and ECO be informed of the fact that a Low Palaeontological sensitivity is allocated on the ground of deep soil cover in the development area. If fresh bedrock is exposed, the possibility of finding fossils is high and any fossils observed must be reported and rescued be a qualified palaeontologist.
- A qualified Palaeontologist must be on site during excavations into fresh bedrock of the Burgersdorp Formation where a Moderate Palaeontological sensitivity is allocated to the site or where the Palaeontological sensitivity allocation increases to a High Palaeontological sensitivity when fresh bedrock is exposed during construction.

11. REFERENCES

Groenewald, G.H., 1996. Stratigraphy of the Tarkastad Subgroup, Karoo Supergroup, South Africa: Unpublished Ph.D. Thesis, University of Port Elizabeth, South Africa, 145 p.

Johnson MR , Anhaeusser CR and Thomas RJ (Eds), 2006. The Geology of South Africa. GSSA, Council for Geoscience, Pretoria, 691pp.

McCarthy, T. and Rubidge, B.S. 2005. The Story of Earth and Life. Struik Publishers, Cape T

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12. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

13. DECLARATION OF INDEPENDENCE

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

Dr Gideon Groenewald
Geologist

APPENDIX A - METHODOLOGY FOR ASSESSING THE SIGNIFICANCE OF IMPACTS

CRITERIA	CATEGORIES	EXPLANATION
Overall nature	Negative	Negative impact on affected biophysical or human environment.
	Positive	Benefit to the affected biophysical or human environment.
Spatial Extent over which impact may be experienced	Site	Immediate area of activity incorporating the 20m zone which extends from the edge of the afforestation area.
	Local	Area up to and/or within 10km of the 'Site' as defined above.
	Regional	Entire community, drainage basin, landscape etc.
	National	South Africa.
Duration of impact	Short-term	Impact would last for the duration of the activity – e.g. activities: Land clearing, land preparation, fertilisation, weeding, pruning and thinning. Quickly reversible.
	Medium-term	Impact would dissipate after the Project activity. E.g. activity: harvesting. Reversible over time.
	Long-term	Impact would persist. E.g. the growth periods between each 'short term' activity.
	Permanent	Impact would continue beyond harvesting/ extraction of the trees.
Probability of occurrence	Unlikely	<40% probability.
	Possible	40% probability.
	Probable	>70% probability.
	Definite	>90% probability.
Mitigation Potential [i.e. the ability to manage or mitigate an impact given the necessary resources and feasibility of application.]	High	Relatively easy and cheap to manage. Specialist expertise or equipment is generally not required. The nature of the impact is understood and may be mitigated through the implementation of a management plan or through 'good housekeeping'. Regular monitoring needs to be undertaken to ensure that any negative consequences remain within acceptable limits. The significance of the impact after mitigation is likely to be low or negligible.
	Moderate	Management of this impact requires a higher level of expertise and resources to maintain impacts within acceptable levels. Such mitigation can be tied up in the design of the Project. The significance of the impacts after mitigation is likely to be low to moderate. May not be possible to mitigate the impact entirely, with a residual impact(s) resulting.
	Low	Will not be possible to mitigate this impact entirely regardless of the expertise and resources applied. The potential to manage the impact may be beyond the scope of the Project. Management of this impact is not likely to result in a measurable change in the level of significance.
Significance of Impact (preliminary only)	Slight	Largely of HIGH mitigation potential.
	Moderate	Largely of MODERATE mitigation potential.
	Substantial	Largely of LOW mitigation potential.