FULL PALAEONTOLOGICAL HERITAGE IMPACT ASSESSMENT REPORT ON THE SITES OF THE PROPOSED IMPLEMENTATION OF THE NGQAMAKHWE REGIONAL WATER SUPPLY SCHEME PHASE 3. PHASE 3 WILL INCLUDE THE TRANSFER, STORAGE AND DISTRIBUTION OF WATER TO THE NGQAMAKHWE TOWN CENTRE AND 29 VILLAGES IN WARDS 13, 16, 18 AND 20 OF THE MNQUMA LOCAL MUNICIPALITY AREA IN THE EASTERN CAPE PROVINCE

Prepared for:
Amathole District Municipality

On behalf of:
Indwe Environmental Consulting CC

Prepared by:
Dr B D Millsteed

5 November 2025

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EXECUTIVE SUMMARY

Amathole District Municipality (ADM), the Water Services Provider (WSP), to undertake the environmental application process for the Ngqamakhwe Phase 3 Water Supply Scheme project. It is the intention of the ADM to implement the Ngqamakhwe Regional Water Supply Scheme Phase 3 to service areas without adequate supply systems in the area. Phase 3 will include the transfer, storage, and distribution of water to the Ngqamakhwe Town Centre and 29 villages in Wards 13, 16, 18 and 20 of the Mnquma Local Municipality area in the Eastern Cape Province. The proposed development involves the implementation of a regional water supply scheme to supply potable water to the Greater Ngqamakhwe area. Several options for providing water to the area have been considered and include the following:

• Surface water from Tsomo River
• Groundwater from existing boreholes
• Delay water supply until the implementation of the full Ngqamakhwe Regional Water Supply Scheme (RWSS)

The project lies within the 1:50,000 topographic map King Williams Town 3128, and extends between 31° 33′ 0.97″S, 28° 06, 4.86″ E to the west, and 31° 33′ 0.97″S, 28° 9′ 15.91″E to the east.

Indwe Environmental Consulting CC have been appointed by Sontinga Consulting through Amathole District Municipality (ADM), the Water Services Provider (WSP), to undertake the environmental application process for the Ngqamakhwe Phase 3 Water Supply Scheme project. Barry Millsteed Geological service (Pty) Ltd has been appointed by Indwe Environmental Consulting CC CE-to conduct a Full Heritage Impact Assessment (HIA) study (inclusive of a Desktop Palaeontological Impact Assessment (Desktop PIA) in terms of Section 38 (3) of The National Heritage Resources Act (NHRA), No. 25 of 1999 for the proposed project. This Palaeontological Impact Assessment will form part of a Heritage Impact Assessment report that will contribute to the Environmental Assessment process.

A site visit of the project area was conducted by Dr B. Millsteed on 11-12/09/2025. Any negative impact upon the fossil heritage of the area will be permanent and irreversible, but of localised scale and unsure probability. This report summarises the findings of that study. The installation of the project's required infrastructure will impact upon potentially fossiliferous bedrock of the Katberg Formation. This formation is known to contain vertebrate fossils of the scientifically significant *Lystrosaurus declivis* Assemblage Zone as well as associated plant fossils of the *Glossopteris* flora. A series of damage mitigation protocols are outlined herein

It is the considered opinion of Dr Millsteed that if the proposed damage mitigation protocols are implemented there is no reason for the proposed project not to proceed. Indeed, the project would provide a significant opportunity for fossil materials to be located and for them to be made available to science.

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Amathole District Municipality (ADM), the Water Services Provider (WSP), to undertake the environmental application process for the Ngqamakhwe Phase 3 Water Supply Scheme project. It is the intention of the ADM to implement the Ngqamakhwe Regional Water Supply Scheme Phase 3 to service areas without adequate supply systems in the area. Phase 3 will include the transfer, storage, and distribution of water to the Ngqamakhwe Town Centre and 29 villages in Wards 13, 16, 18 and 20 of the Mnquma Local Municipality area in the Eastern Cape Province (Figure 1). The proposed development involves the implementation of a regional water supply scheme to supply potable water to the Greater Ngqamakhwe area. Several options for providing water to the area have been considered and include the following:

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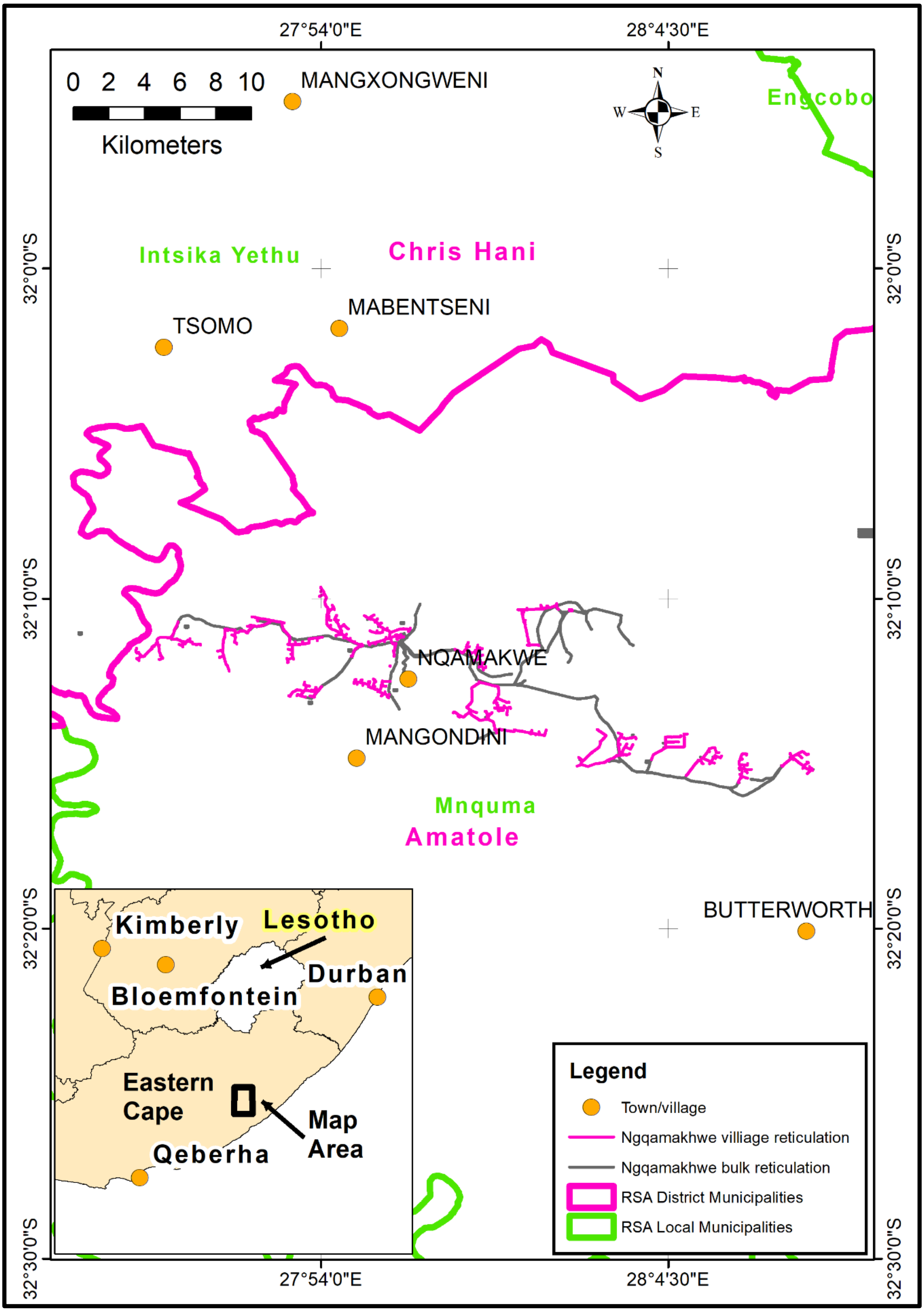

Figure 1: Location of the eight proposed project infrastructure within the Amatola District Municipality and Mnquma Local Municipality of the Eastern Cape Province.

2 TERMS OF REFERENCE AND SCOPE OF THE STUDY

The terms of reference for this study were as follows: -

- .Conduct a site survey of the project area.
- Identify all palaeontological materials located in the area of the project area.
- Quantify the palaeontological heritage significance of any fossil materials identified.
- Describe the possible impact of the proposed development on the palaeontological heritage of the site, according to a standard set of conventions.
- Recommendations for any future work that may be required (including a monitoring protocol and fossil finds procedure to mitigate the possible negative impacts of the proposed project on heritage resources) as well as any other suitable mitigation measures to minimise possible negative impacts, if any are identified, on the palaeontological heritage of the site.
- Provide an overview of the applicable legislative framework.

3 LEGISLATIVE REQUIREMENTS

South Africa's cultural resources are primarily dealt with in two Acts. These are the National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998).

6.2 The National Heritage Resources Act

The following are protected as cultural heritage resources by the National Heritage Resources Act:

- Archaeological artefacts, structures, and sites older than 100 years,
- Ethnographic art objects (e.g. prehistoric rock art) and ethnography,
- Objects of decorative and visual arts,
- Military objects, structures, and sites older than 75 years,
- Historical objects, structures, and sites older than 60 years,
- Proclaimed heritage sites,
- Graveyards and graves older than 60 years,
- Meteorites and fossils,
- Objects, structures, and sites or scientific or technological value.

The Act also states that those heritage resources of South Africa that are of cultural significance or other special value for the present community and for future generations must be considered part of the national estate and fall within the sphere of operations of heritage resources authorities. The national estate includes the following:

- Places, buildings, structures, and equipment of cultural significance,
- Places to which oral traditions are attached or which are associated with living heritage,
- Historical settlements and townscapes,

- Landscapes and features of cultural significance,
- Geological sites of scientific or cultural importance,
- Sites of Archaeological and palaeontological importance,
- Graves and burial grounds,
- Sites of significance relating to the history of slavery,
- Movable objects (e.g. archaeological, palaeontological, meteorites, geological specimens, military, ethnographic, books etc.).

6.3 Need for Impact Assessment Reports

Section 38 of the Act stipulates that any person who intends to undertake an activity that falls within the following:

- The construction of a linear development (road, wall, power line, canal etc.) exceeding 300m in length,
- The construction of a bridge or similar structure exceeding 50m in length,
- Any development or other activity that will change the character of a site and exceed 5,000m^2 or involve three or more existing erven or subdivisions thereof,
- Re-zoning of a site exceeding 10,000m^2,
- Any other category provided for in the regulations of SAHRA or a provincial heritage authority.

must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature, and extent of the proposed development. If there is reason to believe that heritage resources will be affected by such development, the developer may be notified to submit an impact assessment report. A Palaeontological Impact Assessment (PIA) only looks at the potential impact of the development of palaeontological resources in the proposed area to be affected.

6.4 Legislation Specifically Pertinent to Palaeontology*

*Note: Section 2 of the Act defines "palaeontological" material as "any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains".

Section 35(4) of this Act specifically deals with archaeology, palaeontology, and meteorites. The Act states that no person may, without a permit issued by the responsible heritage resources authority (national or provincial):

- Destroy, damage, excavate, alter, deface, or otherwise disturb any archaeological or palaeontological site or any meteorite,

- Destroy, damage, excavate, remove from its original position, collect, or own any archaeological or palaeontological material or object or any meteorite,
- Trade in, sell for private gain, export, or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
- Bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment that assists in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites,
- Alter or demolish any structure or part of a structure which is older than 60 years as protected.

The above-mentioned palaeontological objects may only be disturbed or moved by a palaeontologist, after receiving a permit from the South African Heritage Resources Agency (SAHRA). In order to demolish such a site or structure, a destruction permit from SAHRA will also be needed.

Further to the above point, Section 35(3) of this Act indicates that "any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority". Thus, regardless of the granting of any official clearance to proceed with any development based on an earlier assessment of its impact on the Palaeontological Heritage of an area, the development should be halted and the relevant authorities informed should fossil objects be uncovered during the progress of the development.

6.5 The National Environmental Management Act [as amended]

This Act does not provide the detailed protections and administrative procedures for the protection and management of the nation's Palaeontological Heritage as are detailed in the National Heritage Resources Act but is more general in its application. In particular Section 2(2) of the Act states that environmental management must place people and their needs at the forefront of its concerns and, amongst other issues, serve their cultural interests equitably. Further to this point section 2(4)(a)(iii) states that disturbances of sites that constitute the nation's cultural heritage should be avoided, and where it cannot be avoided should be minimised and remedied.

Section 23(1) indicates that a general objective of integrated environmental management is to identify, predict and evaluate the actual and potential impact of activities upon the cultural heritage. This section also highlights the need to identify options for mitigating of negative effects of activities to minimise negative impacts.

To give effect to the general objectives of integrated environmental management outlined in the Act the potential impact on the cultural heritage of activities that require authorisation or permission by law must be investigated and assessed before their implementation and reported to the relevant organ of state. Thus, a survey and evaluation of cultural resources must be done in areas where development projects that will potentially negatively affect the cultural heritage will be performed. During this process the impact on the cultural heritage will be determined and proposals for the mitigation of the negative effects made.

4 RELEVANT EXPERIENCE

Dr Millsteed holds a PhD in palaeontology and has previously been employed as a professional palaeontologist with the Council for Geoscience in South Africa. He is currently the principal of Barry Millsteed Geological Services (Pty) Ltd and has sufficient knowledge of palaeontology and the relevant legislation required to produce this Palaeontological Impact Assessment Report. Dr Millsteed is registered with the South African Council for Natural Scientific Professions (SACNASP), is a member of the Palaeontological Society of South Africa, Australasian Palaeontologists and is a Fellow of both the Geological Societies of South Africa and Australia.

5 METHODOLOGY

A site visit of the project area was conducted by Dr B. Millsteed on 11-12/09/2025. The most effective methodology in both areas for determining the fossiliferous potential of the project area was determined to be to traverse available roads by vehicle to locate accessible rock exposures (e.g., road cutting and borrow pits, etc). Special attention was placed on the examination of any bedrock outcrops that may be present within the project area by foot. These outcrops were investigated to determine their lithology and fossil content. The entire extent of the project area was not directly observed (due to time and financial budget constraints. The path of the traverses was recorded as a trackway on a hand-held GPS and is indicated in Figure 2. Photographs were taken, and observations were taken at several locations (see waypoint locations in Figure 2). The location of the photographs and observation points was recorded using a hand-held GPS.

In some of the project area the available roads were not considered accessible by car; in other portions of the project area there was no roads at all. However, it is believed, herein, that the area investigated was representative of the entire project area and its bedrock geology.

6 ACCESS AND INDEPENDENCE

The site visit and inspection was conducted completely free of any hindrance. Access was freely available to all portions of the study area and the field visit was able to be conducted wherever it was deemed necessary for the satisfactory completion of the study. That said, there were portions of the project area were not accessible by road. However, it is considered, herein, that the full extent of the project (east-west) was covered and that the area visited was representative of the projects bedrocks types and allows a realistic evaluation of the projects potential impact on the site’s fossil heritage.

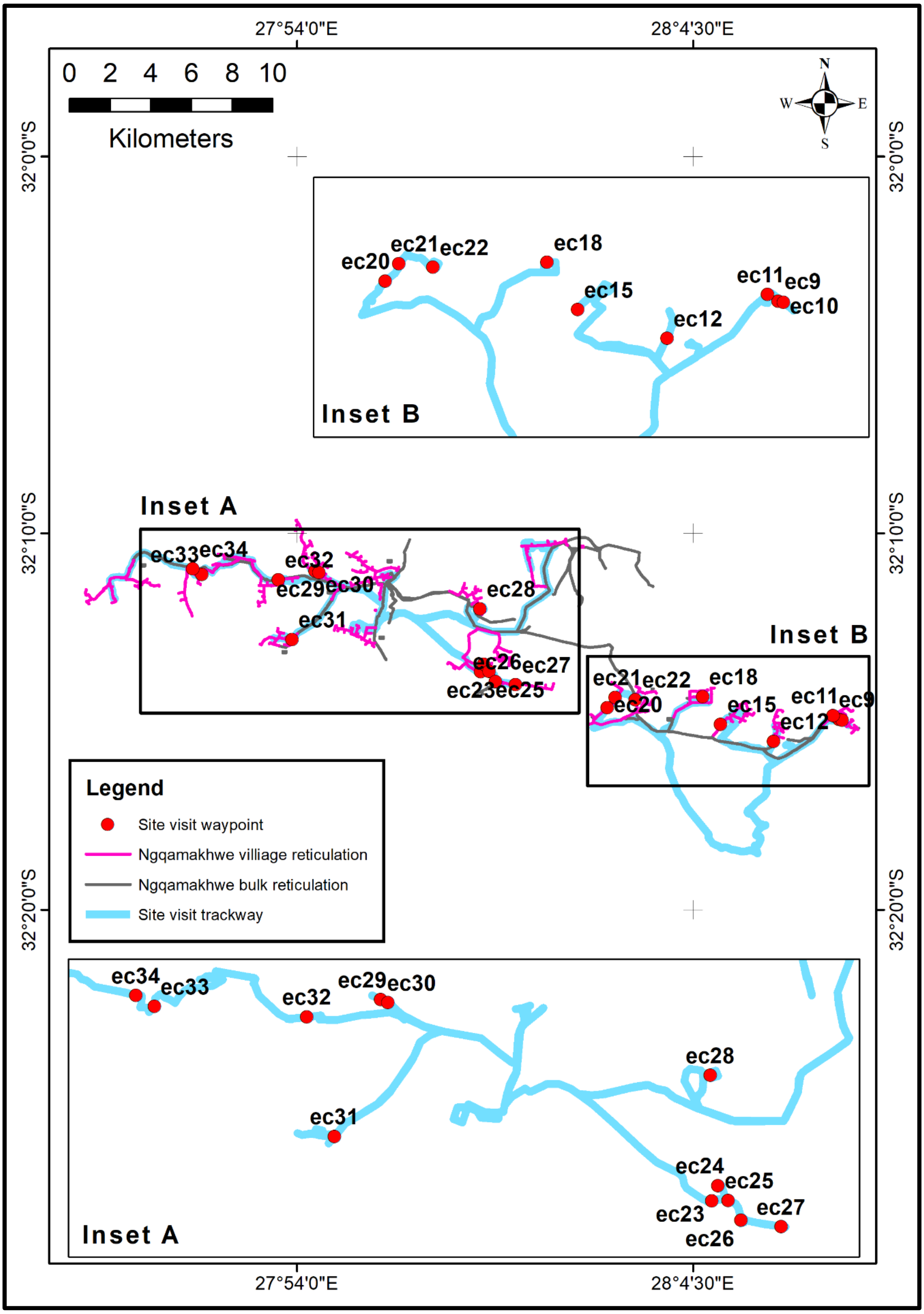

Figure 2: Map of the location of traverses conducted within the is study (thick blue lines) as well as the total extent of the planned project infrastructure (purple lines) as well as existing infrastructure elements (grey lines). Data waypoints are shown via red circles.

The land surface in within the region is highly undulatory, but the valleys become markedly deeper in the western portions of the site. Ubiquitous regolith cover masks the bedrock (particularly in the eastern portions of the project, but outcrops become more frequent in the west).

Dr Millsteed was contracted as an independent consultant to conduct this Palaeontological Heritage Impact Assessment study and shall receive fair remuneration for these professional services. Neither Dr Millsteed nor Barry Millsteed Geological Services (Pty) Ltd has any financial interest either in the construction of the proposed bridges nor any companies or individuals associated with the project.

7 GEOLOGY AND FOSSIL POTENTIAL

The region surrounding the project area is entirely underlain by rocks of the Permian Adelaide and Triassic Tarkastad Subgroups, Karoo Supergroup (Figure 3). Examination of the 1:250,000 Geological Sheet 3226 King William's Town (Geological Survey of South Africa, 1976) indicates that the bedrocks underlying the project infrastructure are indeed the Balfour Formation of the Adelaide Subgroup and the Katberg formation of the Tarkastad Subgroup. It is also evident from Figure 3 that extensive areas of the project and its environs are underlain by intrusive rocks of the Karoo Dolerite Suite.

7.1 Balfour Formation (Adelaide Subgroup, Beaufort Group, Beaufort Group)

7.1.1 Geology

In the southeastern part of the Main Karoo Basin the Late Permian Adelaide Subgroup includes (in decreasing order of age) the Koonap, Middleton and Balfour Formations (Johnson et al., 2006). Thus, the Balfour Formation directly stratigraphically underlie the younger sediments of the Tarkastad Subgroup. The Koonap Formation attains a maximum thickness of about 1300 m, the Middleton 1600 m (although it may be as much as 2500 m and the Balfour Formation 2000 m (Johnson et. al., 2006).

In the southern and central parts of the basin the Adelaide Subgroup consists of alternating bluish-grey, greenish-grey or greyish-red mudrocks and grey, very fine- to medium-grained lithofeldspathic sandstones. north of Port Elizabeth). Individual sandstone units are thickest (average 6 m; maximum 60 m) in the south and become thinner northwards. The mudrocks in the Adelaide Subgroup are generally massive and blocky weathering except in parts of the Normandien Formation (in the north of the Karoo Basin) and the Daggaboersnek Member (in the north east of the basin), where horizontal lamination is common and rhythmites are often present. Desiccation cracks and raindrop impressions are occasionally present. Calcareous nodules and concretions occur in mudstones throughout the Beaufort Group (Johnson et al., 2006).

The ubiquitous fining-upward cycles, the terrestrial biota, the abundance of red mudrocks and the characteristic suite of sedimentary structures point unequivocally to deposition under fluvial conditions, with the lowermost strata in some areas probably representing a subaerial upper delta-plain environment. The high mud/sand ratios and fine-grained character of the sandstones indicate meandering rather than braided rivers, with the sandstones having formed as channel deposits and the mudstones representing over bank deposits that settled from suspension on the adjacent floodplains. The tabular siltstones and thin sandstones interbedded with mudstone units are presumably levee deposits, with the thin horizontally laminated sandstones probably representing crevasse splay deposits (Smith, 1980).

7.1.2 Palaeontological Potential

Terrestrial vertebrate fossils are common in the Adelaide Subgroup. Fish remains, non-marine molluscs, invertebrate burrows and trails, silicified wood and stem impressions occur sporadically throughout the subgroup. Well-preserved leaf impressions (mainly Glossopteris) are common in the Daggaboersnek Member and Normandien Formation (Johnson et al., 2006). Both and Smith (2020) have assigned the upper-most strata of the upper Palingkloof Member of the Balfour formation as well as the strata of the Katberg Formation and Bergersdorp Formations to their *Lystrosaurus declivis* Assemblage Zone.

The available 1:250,000 geological sheet covering the study area does not differentiate the Balfour Formation into separate members. It is evident from Figure 4 that the *Lystrosaurus declivis* Assemblage Zone extends westwards from immediately west of Umthatha. It is accordingly accepted herein that the Balfour Formation rocks underlying the project area fall within the *Lystrosaurus declivis* Assemblage Zone.

Botha and Smith (2025) indicate that the Early Triassic *Lystrosaurus declivis* Assemblage Zone has long been recognised is a particularly significant biozone in palaeoecological and palaeoenvironmental studies as it contains a community assemblage that records the survival and recovery from the end-Permian mass extinction. It represents the best record globally of the ecological changes in terrestrial community structure and stability during this time period. The assemblage is dominated by two species of small to medium-sized herbivorous dicynodonts *L. declivis* and *L. murrayi* that co-occur in equal abundance, along with a range of smaller and less common faunivorous and insectivorous taxa. The *Lystrosaurus declivis* Assemblage Zone of the main Karoo Basin hosts the type locality of the global Lootsbergian land-vertebrate faunachron. The biozone is one of the most widespread terrestrial faunal assemblages of western Gondwana with closely related species occurring in India and Antarctica. Similar, but much more distantly related taxa, occur in Induan-aged strata of Russia, China and Brazil.

A list of fossil taxa occurring within the *Lystrosaurus declivis* Assemblage Zone is provided in Table 1. the *Lystrosaurus declivus* may be expected to occur vertebrate fossils, invertebrate arthropoda, plant macrofossils, and both vertebrate and invertebrate trace fossils.

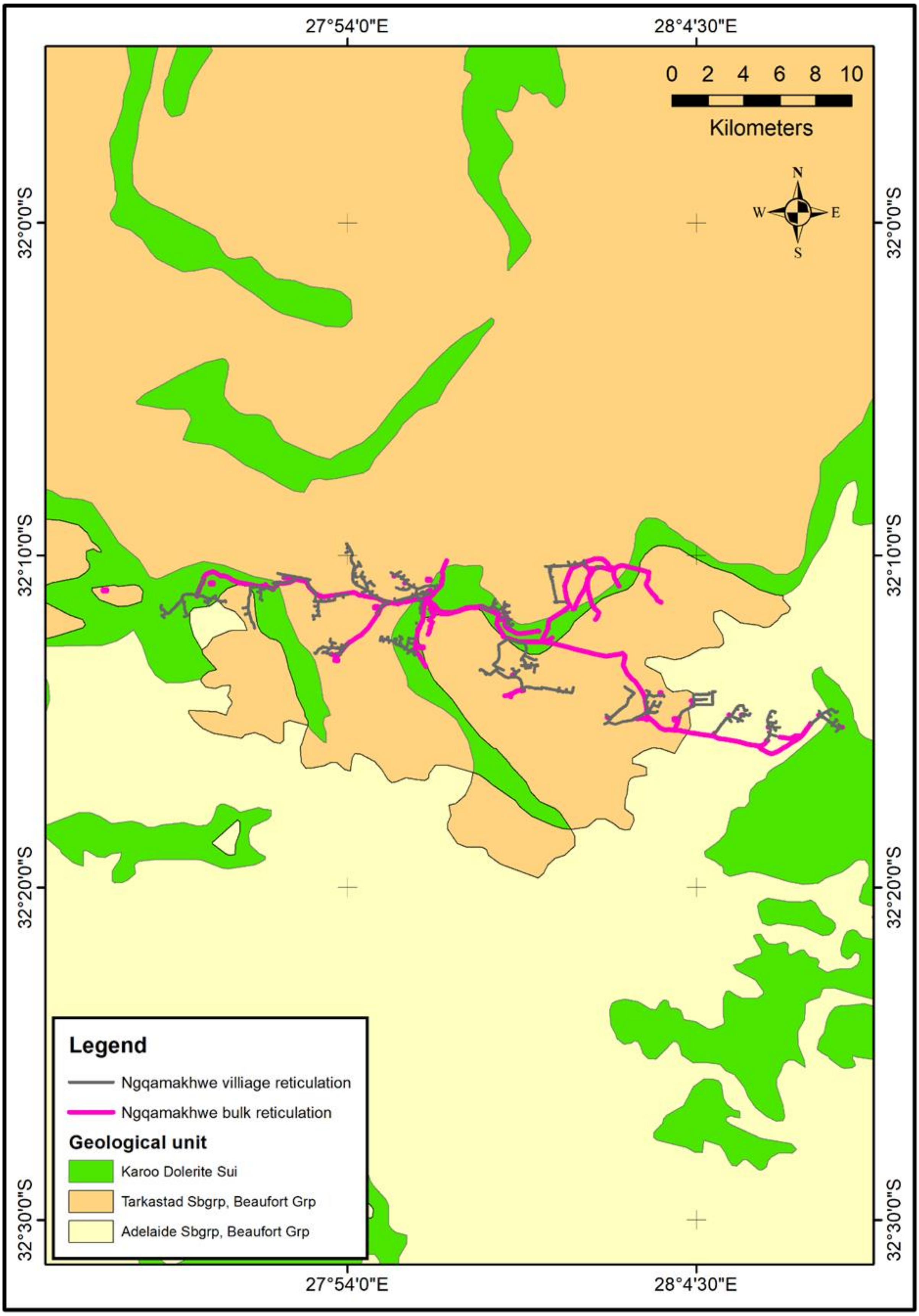

Figure 3: Geological map of the bedrock geology underlying the project area and its environs.

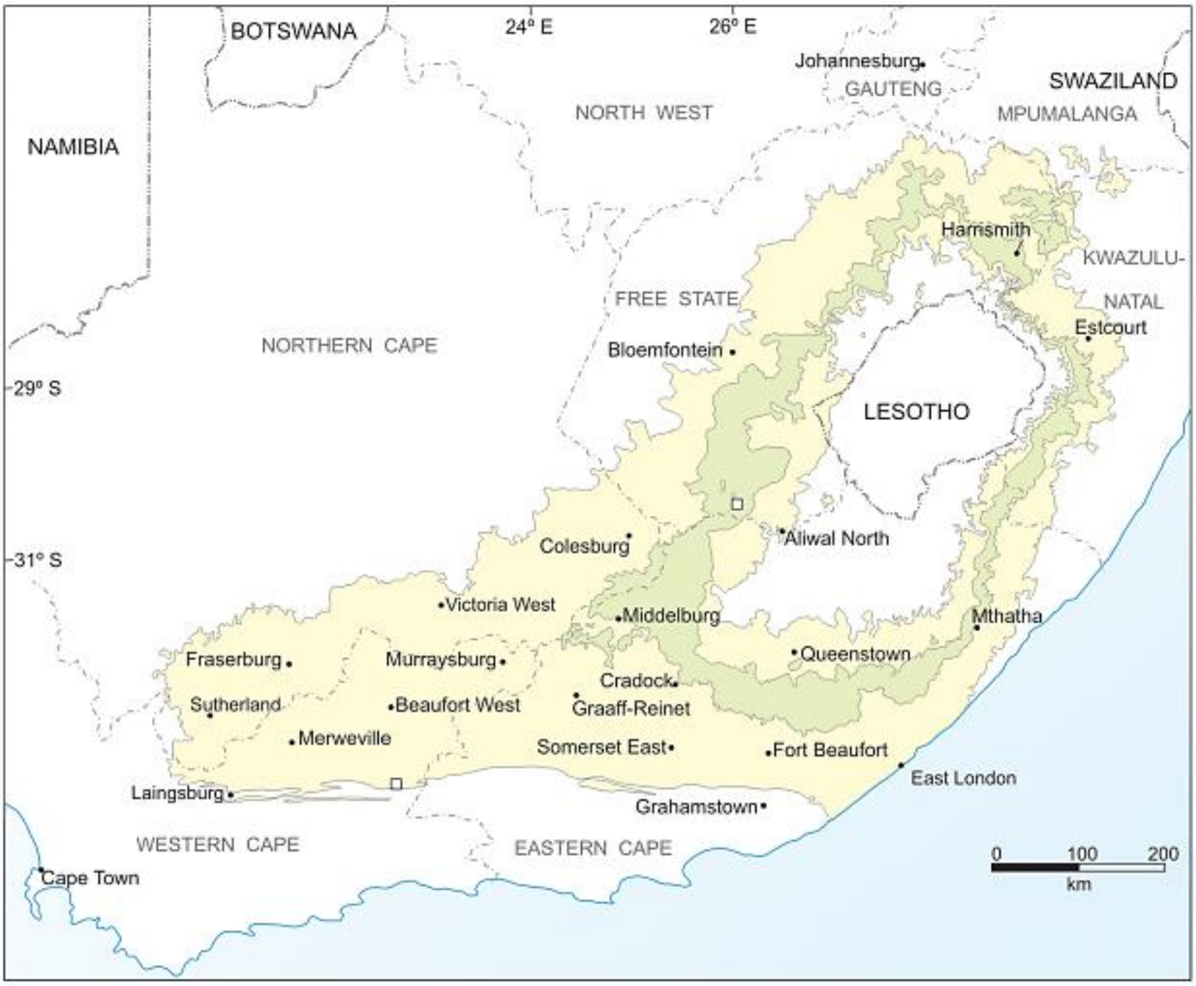

Figure 4: Distribution of the *Lystrosaurus declivis* Assemblage Zone (green) in the Beaufort Group (yellow) (Botha and Smith, 2020).

Table 1: List of palaeontological taxa known to occur within the *Lystrosaurus declivis* Assemblage Zone (modified from Botha and Smith, 2020).

VERTEBRATES	
Amphibia	*Micropholis stowi*
	Thabanchuia oomie
	Lydekkerina huxleyi
	Eolydekkerina magna
	Broomulus dutoiti
	Kestrosaurus dreyeri
	Broomistega putterilli
	Rhytidosteus capensis
	Trematosauridae indet.
Amniota	
Parareptilia	*'Owenetta' kitchingorum*

	Saurodektes rogersorum
	Sauropareion anoplus
	Coletta seca
	Phonodus dutoitorum
	Procolophon trigoniceps
Eureptilia	
Lepidosauromorpha	*Paliguana whitei*
Archosauromorpha	*Heleosuchus griesbachi*
	Noteosuchus colletti
	Prolacerta broomi
	Proterosuchus fergusi
Synapsida	
Therapsida	
Anomodontia	*Myosaurus gracilis*
	Lystrosaurus curvatus
	Lystrosaurus murrayi
	Lystrosaurus declivis
	Lystrosaurus maccaigi
Therocephalia	*Ericiolacerta parva*
	Moschorhinus kitchingi
	Olivierosuchus parringtoni
	Promoschorhynchus platyrhinus
	Regisaurus jacobi
	Scaloposaurus constrictus
	Tetracynodon darti
Cynodontia	*Progalesaurus lootsbergensis*
	Galesaurus planiceps
	Thrinaxodon liorhinus
	Platycraniellus elegans
INVERTEBRATES ARTHROPODA	cf. *Gymnostreptus*
PLANTS	*Agathoxylon*
	Glossopteris
	Trizygia speciosum
	Paracalamites
TRACE FOSSILS INVERTEBRATE	*Katbergia*
	Scoyenia
	Macanopsis
	Gyrolithes/Daimonelix
	Cylindrical
	Planolites
	Skolithos
TRACE FOSSILS VERTEBRATE	*Thalassinoides* (*Procolophon*)

	Histioderma (*Lystrosaurus*)
	Dicynodontipus
	Procolophonichnium
	Rhynchosauroides

7.2 Katberg Formation, Tarkastad Subgroup, Beaufort Group

7.2.1 Geology

It is evident in **Error! Reference source not found.** that the majority of the project area (i.e., the central and western portions) are underlain by rocks the Tarkastad Subgroup of the Beaufort Group (Karoo Supergroup). In this instance, the basal unit of the Tarkastad unit is the Katberg Formation. It is accepted, herein, that the central and western portions of the project area are underlain by rocks of the Katberg Formation. This stratigraphic identification is supported by the extreme thickness of the stacked sandstone beds observed in these regions during the site visit.

The Early Triassic Tarkastad Subgroup is characterised by a greater abundance of both sandstone and red mudstone than the underlying Adelaide Subgroup Johnson et al., (2006). The subgroup attains a maximum thickness of close to 2,000 m in the south of its outcrop area. This reduces to around 800 m in the middle of its outcrop area and it ultimately thins to 150 m or less in the far north (Groenewald, 1989). In the south of the outcrop area, the Tarkastad Subgroup comprises a lower Katberg Formation (sandstone-rich) and an upper Burgersdorp Formation (mudstone-rich). Sandstone constitutes over 90% of the Katberg Formation in the small coastal exposures near East London (where it is over 900 m thick) and the southernmost part of the main outcrop area. However, the sandstone/mudstone ratio decreases steadily northwards until the formation becomes difficult to distinguish from the Burgersdorp Formation. The latter is around 1000 m thick in the southern outcrop area, with the overall sandstone content diminishing from possibly 50% (Johnson et al., 2006).

7.2.2 Palaeontological potential

In the Eastern Cape, the entire Katberg Formation is ascribed to the *Lystrosaurus declivis* Assemblage Zone (Botha and Smith, 2020). Elsewhere, the assemblage zone can be found in the upper Palingkloof Member of the Balfour Formation East of 24°E, and equivalent Harrismith Member of the Normandien Formation in the Northern Free State Province, as well as the entire Katberg Formation of the Tarkastad Subgroup, Karoo Supergroup (Groenwald and Kitching, 1995; Neveling, 2004; Smith and Botha-Brink, 2014).

The Lystrosaurus declivis Assemblage one is expected to occur within the Katberg Formation are the same as those expected in the Balfour Formation (where they underlie the project area). A list of these taxa is provided in Table 1. However, it is evident in Figure 5 that the stratigraphic ranges of some taxa within the assemblage zone are not the same in the two formations. Thus, different taxa may occur in either of the stratigraphic units.

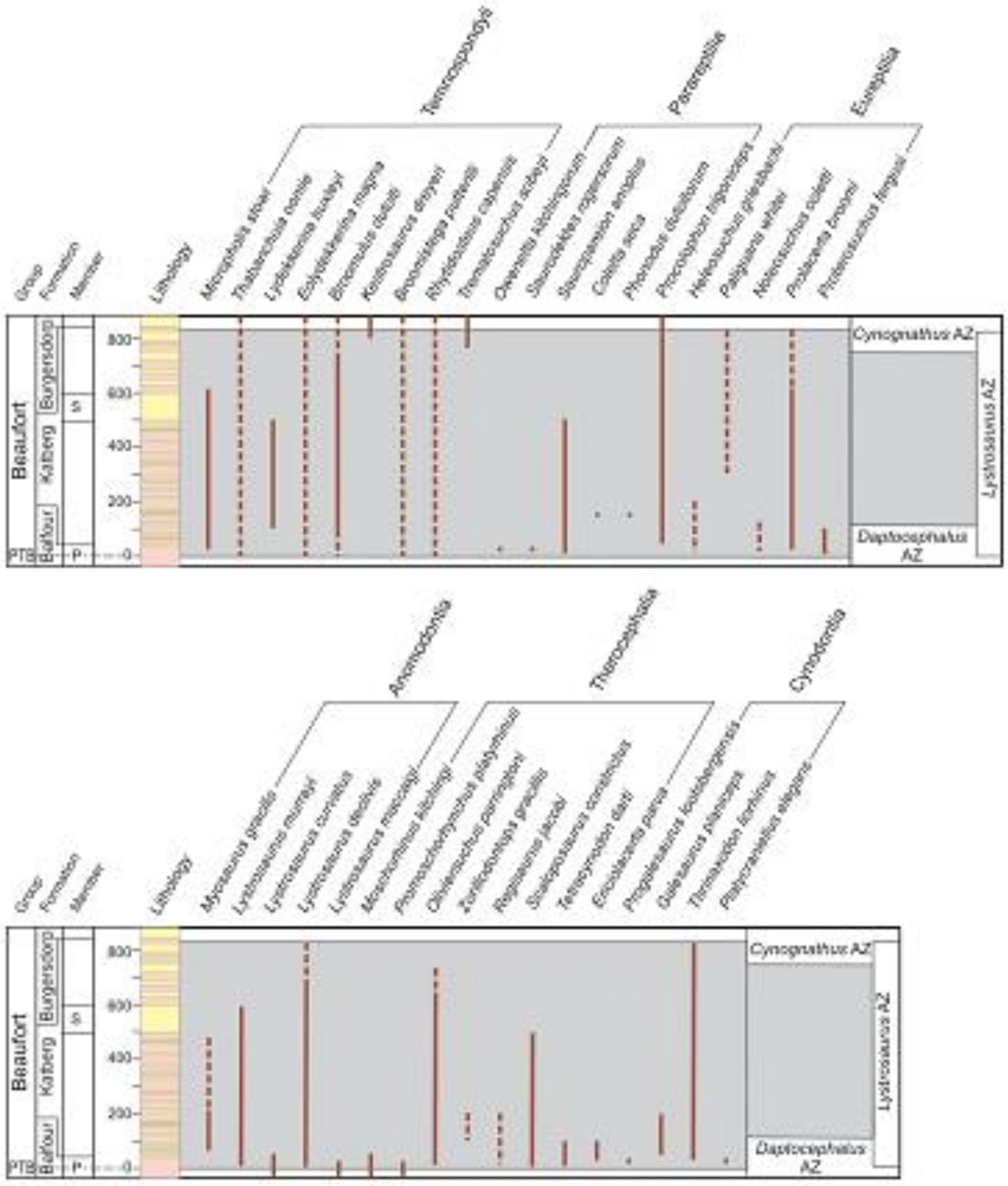

Figure 5: *Composite stratigraphic section showing the biostratigraphic ranges of the vertebrate taxa found within the Lystrosaurus declivis Assemblage Zone (Botha and Smith, 2020).*

7.3 Karoo Dolerite Suite

7.3.1 Geology

The geological map of the region shows that the dolerites located within the project area and surrounding region are present as a series of dykes of the Jurassic age (approximately 183 million years old; Duncan and Marsh, 2006) Karoo Dolerite Suite. Figure 3 is compiled from historical regional scale mapping of the region (including the possibility of many components being derived from air photo interpretation in the pre-GPS era and accordingly subject to some degree of location error) and suggests that some project area underlying bridge 8 may indeed be Karoo Dolerite Suite rocks.

7.3.2 Palaeontological potential

Dolerite is an intrusive igneous rock, as such there is no potential for any fossil material to be located within this rock type.

7.4 Quaternary Alluvium

7.4.1 Geology

The land surface of the project area is generally depauperate in terms of outcrop. However, the amount of bedrock outcrop increases significantly in the central and western portion of the area where the bedrock is composed of the sandstones of the Katberg Formation.

Figure 6 to Figure 11 depict the land surface of the project area progressing from east to west. It is evident that the majority of the land surface of the project area bears a thick, pervasive vegetation cover of short, dense grass. Accordingly, the area is generally depauperate in terms of outcrop (Figure 6 and Figure 11). Figure 7 suggests that the grasslands grow upon a thin (<20 cm thick horizon of regolith that is probably an *in-situ* soil). Figure 8 to Figure 11 show that in the central and western extents of the project area (upon the bedrocks of the Katberg Formation). The land surface over this region is overwhelmingly comprised of short, dense grasslands. However, the incidence of sandstone outcrops is higher than in the area underlain by the Adelaide Subgroup to the east. The incidence of sandstone outcrops increases significantly in deeply incised valley walls (Figure 10 and Figure 11). However, even in these areas that there is a thin soil horizon evident (upon which the grass grows). It is assumed, herein, that the regolith across the entire extent of the project is composed of this thin *in situ* soil.

Figure 6: View of the thickly grassed land surface at Waypoint ec9 (see Figure 2 for location). No exposures of the regolith are visible.

Figure 7: View to the 280° of a borrow pit at Waypoint ec12 (see Figure 2 for location). The exposed bedrock consists of light yellow to grey coloured stacked, massive mudrock beds. It is evident at the top of the borrow pit that the regolith is thin (<20 cm thick) and composed of darker, soil. No fossils were located in the bedrock.

Figure 8: View of blonde sandstone outcrop at waypoint ec18 (see Figure 2 for location). No fossils were observed.

Figure 9: View of blonde sandstone outcropping on a twin spoor road within a village at Waypoint ec28 (see Figure 2 for location).

Figure 10: View towards 330° of bedded sandstone outcrop 10's of meters thick observed from waypoint ec32 (see Figure 2 for location). These sandstones clearly extend to and underly the adjacent village.

Figure 11: View to 040° of thick (many 10's of meters thick) bedded sandstones of the Katberg Formation observed from Waypoint ec34 (see Figure 2 for location).

7.4.2 Palaeontological potential

Soils are formed in situ from the weathering and decomposition of the underlying bedrock. The resultant total decomposition of the bedrock strata means that it is highly unlikely that any fossil materials contained within the bedrock will survive the development of the regolith horizon. The palaeontological potential of the soils is accordingly assessed as nil.

8 ENVIRONMENT OF THE PROPOSED PROJECT SITE

It is evident in Figure 12 the project area lies within an erosionally heavily dissected landscape. The increasing density of contour lines in Figure 12 indicating an increasing slope of the landscape.

Mucina and Rutherford (2006) indicate that the project area is vegetated with a diverse cover of vegetation zones (Figure 13). The eastern and central portion of the project area are vegetated by Mthatha Moist Grassland, while the western portion is vegetated by Eastern Valley Bushveld. Mucina and Rutherford (*op. cit*.) indicate that the conservation status of both the Mthatha Moist Grassland and the Eastern Valley Bushveld is hardly protected.

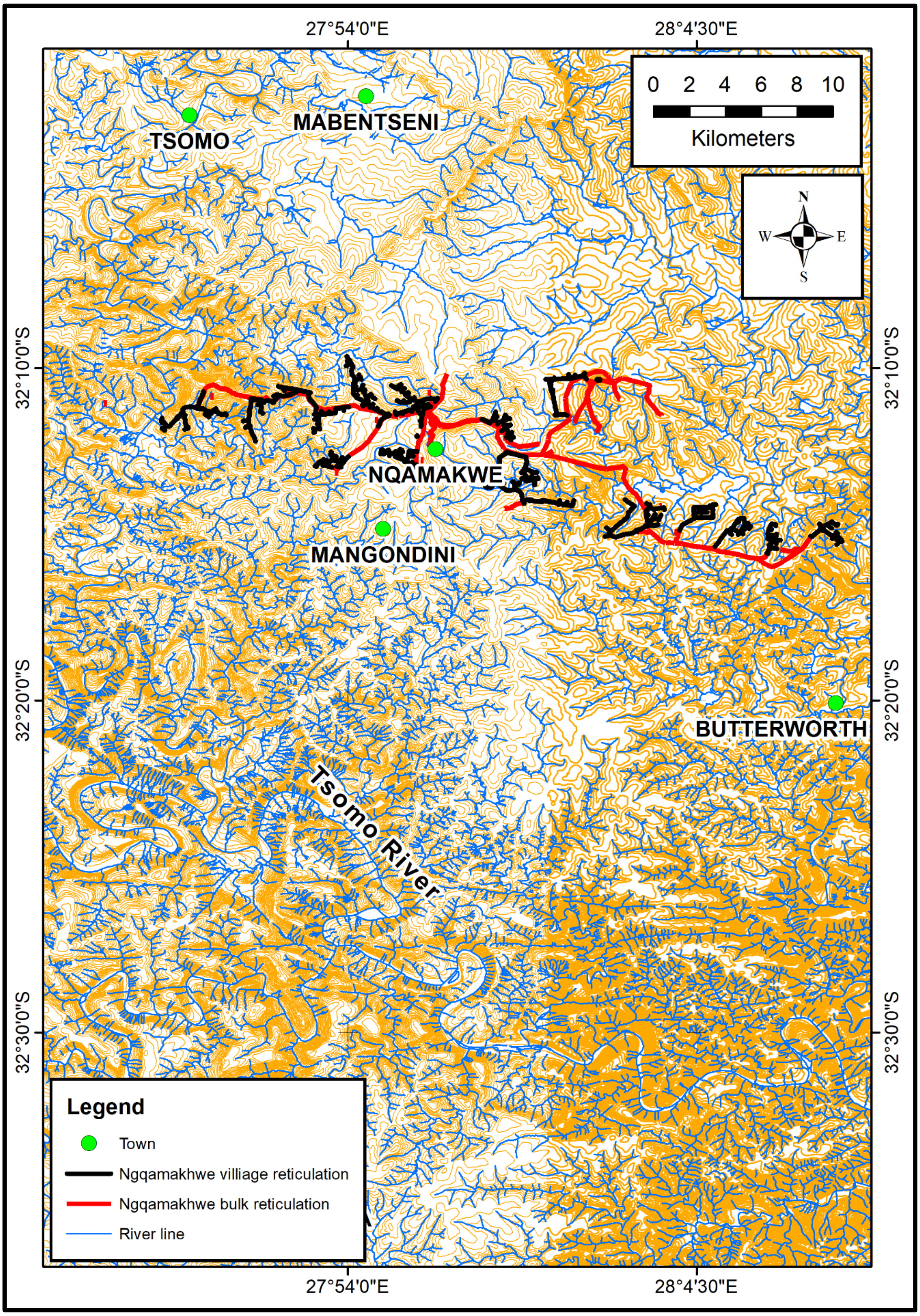

Figure 12: Topographic map of the project area and surrounding environs. The topographic relief line contour interval is 20 m.

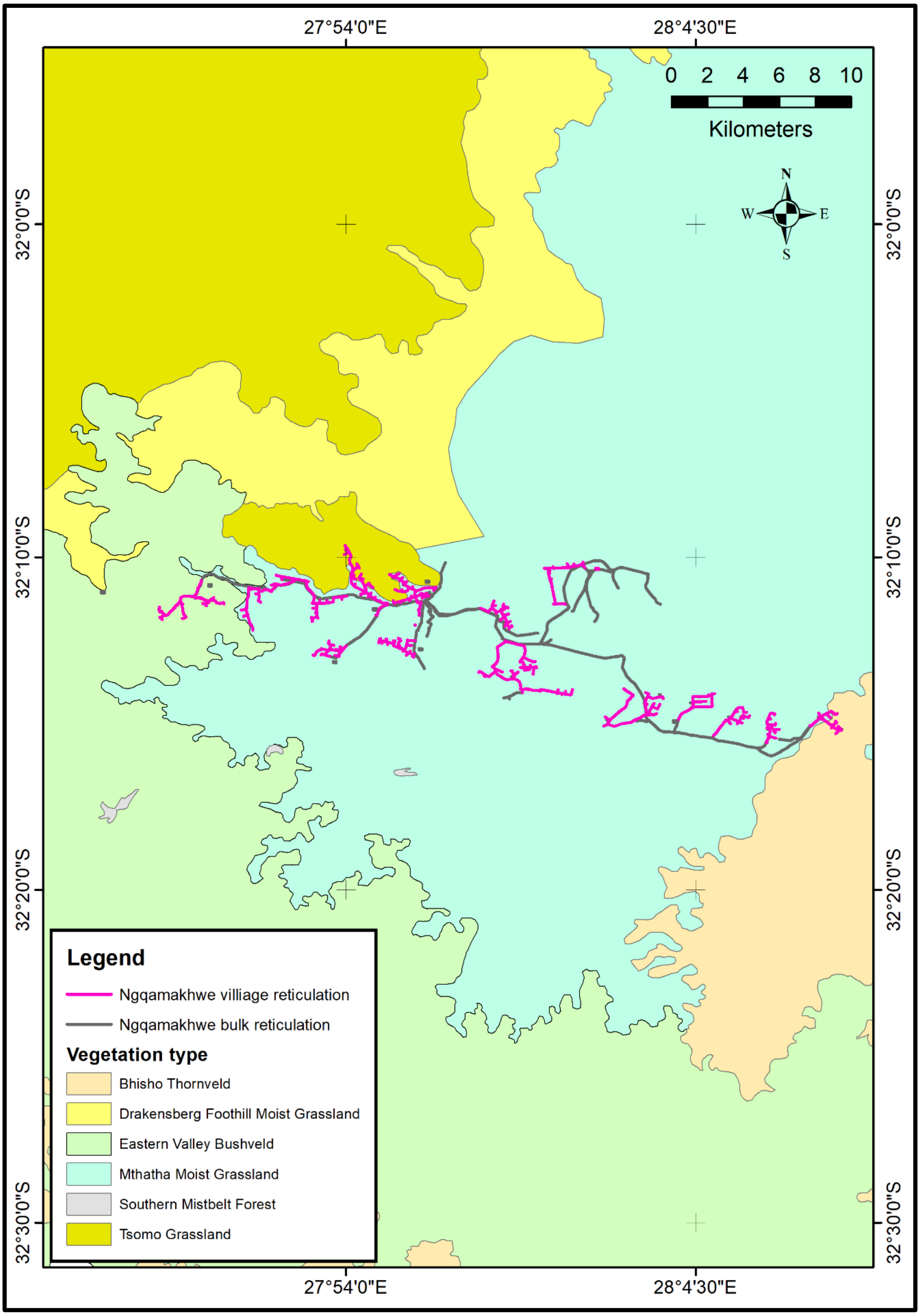

Figure 13: Map of the distribution of the vegetation veld types located within the project area and the surrounding environs (after Mucina and Rutherford, 2006).

9 OVERVIEW OF THE SCOPE OF THE PROJECT

The following infrastructure elements will comprise the project.

Reservoirs and Clear Water Storage

There will be four distribution reservoirs namely Reservoir 2, 5, 9, 14 ranging between 250 and 980kL in capacity. Ten service reservoirs are proposed for Phase 3 ranging between 60 and 175kL in capacity. A total of 48 hours clear water storage for distribution reservoir and 24 hours for the services reservoirs is proposed for Phase 3.

Bulk Mains

The clear water gravity main will be sized to cater for a medium to long term demand of 60l/ capita/ day and will include a transmission loss factor of 10%. To regulate pressure difference, break pressure tanks will be installed at strategic points to dissipate residual pressures.

Reticulation and Standpipes

The reticulation shall be designed to deliver 0.17l/s per standpipe. There may be exceptions where this would not be achieved due to local topography. No pipe smaller than 50mm in diameter shall be used for the reticulation.

The standpipes will be spaced in order for each household to be within 200m walking distance from a standpipe. The total number of standpipes to be installed will be 325.

At the time of compilation of this report the exact details of the installation of the project's infrastructure were not available. However, comparison to similar projects suggests that the following assumptions are made. The maximum depth of excavation of the land surface will be <2 m. This depth will be associated with the installation of water mains pipes. Other pipes will should be emplaced at shallower depths. The water storage tanks will require clearing and levelling of the land surface, but should be essentially established upon the land surface.

10 IMPACT ASSESSMENT

The potential impact of the proposed construction of the infrastructure elements comprising this project is categorised below. The impact rating terminology and evaluation scoring criteria used herein are provided in Appendix 1.

10.1 Nature

Potentially fossiliferous strata are expected to be impacted (destroyed/damaged) by this project, and, as such there may be a negative impact anticipated upon the palaeontological heritage of South Africa.

10.2 Type of Impact

10.2.1 Direct

The direct impacts on the palaeontological heritage of the project area are potentially:

- Damage or destruction of fossil materials during the construction of project infrastructural elements to a maximum depth of those excavations. Many fossil taxa (particularly vertebrate taxa) are known from only a single fossil and, thus, any fossil material is potentially highly significant. Accordingly, the loss or damage to any single fossil can be potentially significant to the understanding of the fossil heritage of South Africa and the understanding of the evolution of life on Earth in general. Where fossil material is present, and will be directly affected by the building or construction of the project's infrastructural elements, the result will potentially be the irreversible damage or destruction of the fossil(s).
- Movement of fossil materials during the construction phase, such that they are no longer *in situ* when discovered. The fact that the fossils are not *in situ* would either significantly reduce or destroy their scientific significance.

However, only unfossiliferous strata are expected to be impacted by the project. It is considered, herein, that the palaeontological heritage of South Africa will not be directly negatively impacted by the project.

10.2.2 Indirect

The indirect impacts upon the palaeontological heritage posed by projects are potentially the loss of access for scientific study to any fossil materials present beneath infrastructural elements for the life span of the existence of the required constructions and facilities. However, for this project the underlying geological strata that are expected to be indirectly impacted upon by the emplacement of the required infrastructure are unfossiliferous. Accordingly, no indirect negative impacts are expected.

10.2.3 Cumulative

The calculation of cumulative effects for palaeontological resources is problematic to calculate. The process of addressing cumulative effect is inherently different for palaeontology compared to other areas of investigation for example: -

- It is possible to calculate the area originally vegetated by a plant biome in a region. The area of original plant cover lost to historical development in the region can also be calculated. The area that would be lost to a proposed development can be calculated and the cumulative loss (either as a percentage) can be calculated.
- The projected light and/or noise pollution from a project can be added to the current night-time light or ambient sound levels, and an assessment can be made if acceptable thresholds on the lifestyle of surrounding communities will be surpassed.
- The current cumulative amount of water being pumped from an aquifer can be calculated. The proposed rates of pumping for a proposed project can be added to

that total and it can, accordingly, be assessed if the cumulative sum of extracted water will exceed the recharge rate for the aquifer leading to its depletion. This case would not only change the operational parameters for the proposed operation but also jeopardise the existing operations in the region that extract water from the reservoir.

Unless fossils are identified in outcropping rocks their presence/abundance in unexposed bedrock is a matter of informed assumption. It is also often the case that a project (e.g., an open-cast mine) will impact upon rock strata that do not crop out and no insight into their palaeontological resources will be gained from a site visit. Thus, even if a site investigation has been conducted, an accurate assessment of the quantum of palaeontological materials in the geological strata of the area will remain open to supposition. Any assessment of the fossil content of a rock unit based on a desktop assessment is even more uncertain. The geological strata in the surrounding region will not be assessed during that site investigation, and probably will not have been the subject of intense investigation by a palaeontologist. It is also possible to make the comparison that most areas investigated as part of a project’s impact assessment process are directly observable/measurable at the Earth’s surface. Plant species present, their abundances and the presence of vulnerable species can be directly observed, measured, and assessed (often over 12 months); animals and birds can be physically counted; archaeological resources can be identified with diligent searching; the light output of a project’s external light sources can be calculated during the design process; groundwater flow can be calculated using either existing or new boreholes. However, most fossil specimens that will be present in the rock strata underlying a project will not be observable at the surface, but rather are enclosed in the bedrock and will be unobservable at the time of the compilation of an impact assessment report.

In the case of this proposed project, the geological strata that will be impacted upon by the installation of the required infrastructure are known to be fossiliferous elsewhere in their extent. However, the volume of bedrock required to be excavated is not large, and the bridges are spread over a wide geographical extent. There is little in the way of built structures over most of the extent of the project area, so the cumulative impact should be considered to be low. Any potential negative cumulative effect should be weighed against possible positive cumulative impact as the palaeontological record in this portion of South Africa is relatively poorly known compared to other regions, because of extensive vegetation and regolith cover. Accordingly, any fossil materials that may be uncovered during the construction of the bridges are potentially scientifically and culturally important.

10.3 Duration of Impact

The anticipated duration of the identified potential impact for the area underlying the construction of the bridges is assessed as **permanent** if fossils are likely to be impacted upon. The negative impacts caused by the installation of the project site impacts will be temporary, and restricted to the time span required to build each bridge.

10.4 Extent of Impact

The extent of the area of potential impact upon the bedrock is categorised as **localised** (i.e., restricted to the location of the project infrastructure).

10.5 Significance of the Impact

The geological strata that are expected to be impacted upon by this project are potentially fossiliferous. They are known to contain a range of fossil types, but perhaps most notably vertebrate fossils of the *Lystrosaurus declivis* Assemblage Zone. The fossils of this biozone provide world-class insight into the evolution of vertebrate taxa at this time in Earth's history.

Karoo-age rocks of South Africa preserve one of the most complete lithological and palaeontological successions in the world documenting the evolutionary transition from reptiles to mammals. Any one fossil found may represent an advancement in the scientific understanding of that process. Similarly, the destruction or damage of a particular fossil may represent a significant loss to the scientific community.

10.6 Consequence

The consequence of any impact on the palaeontological heritage of South Africa will potentially vary from slight to severe in the absence of damage mitigation processes. The variance is dependent upon the type and number of fossils impacted upon. However, the consequences could be highly beneficial with mitigation safeguards in place.

10.7 Probability of Impact

The presence of a fossil in any particular area is low in general. However, it is also highly variable Some types of fossils often occur in large numbers in a particular rock layer (e.g., bone beds, mass mortality events etc). Plant macrofossils may be abundantly distributed throughout a sequence. As a result, the probability of a negative impact occurring upon the Palaeontological heritage of the project area is assessed as **unsure.**

11 DAMAGE MITIGATION, REVERSAL AND POTENTIAL IRREVERSIBLE LOSS

The degree to which the possible negative effects of the proposed project can be mitigated, reversed, or will result in irreversible loss of the palaeontological heritage can be determined as discussed below.

11.1 Mitigation

The volume of bedrock that will be disturbed by the construction of This water reticulation system will be large, when the entire extent of the project's surface area is considered. Although the cross section of each excavation will be small (e.g. wide enough to bury pipes to a maximum of 2 m deep), the cumulative volume of rock to be excavated means that it is probable that fossil materials will be negatively impacted. Added to this scenario is that the palaeontology of the Eastern Cape is poorly understood compared to other parts of South Africa. As such, any fossils located would potentially add significantly to the understanding of the faunas in this biozone. Accordingly, is proposed, herein, that damage mitigation and fossil-find protocols need to be put in place to safeguard the palaeontological heritage of the region.

The following mitigation protocols are recommended:

1) Excavations made as part of the implementation of this project, as well as any areas cleared (e.g., the footprint of storage tanks) should be examined by a suitably experienced Karoo palaeontologist to ascertain if fossils are present.
2) However, the project has a large aerial extent, and it is expected that the installation of the infrastructure elements will occur over a protracted period of time.
3) Thus, it would not be financially viable to have a palaeontologist permanently based on site for the duration. Nor would it be financially viable to have frequent visits made, as his would be prohibitively expensive and would only provide selected "snapshots" of the palaeontological potential of the excavations (as they will be infilled as soon as the pipelines are laid).
4) Before commencement of the project one person in the staff (e.g., site foreman, or Environmental Control Officer [ECO]) must be identified and appointed as responsible for the implementation of the damage mitigation protocol outlined herein. In instances of accidental fossil discovery this must be reported to the ECO or site manager. If the ECO or site manager is not present on site, then the responsible person on site should follow the protocol correctly in order to not jeopardize the conservation and well-being of the fossil material. It must be accepted, however, that damage or destruction may occur to fossils as they will be uncovered by industrial machinery.
5) Workmen and foremen need to be trained by the appointed palaeontologist in the procedure to follow in instances of accidental discovery of fossil material. Training via a video conference is suggested as a cost-effective methodology. A brief introduction to the process to follow in the event of possible accidental discovery of fossils should be conducted to the staff by the designated Environmental Control Officer, or the foreman or site agent in the absence of the ECO. This will allow all staff to be prepared in the event that accidental discovery of fossil material takes place.
6) Once a workman notices possible fossil material, he/she should report this to the ECO or site agent.
7) Should staff identify fossil materials work in that area should be immediately suspended, and the appointed palaeontologist immediately informed by the appointed company agent. Photographs of the fossil material (and, if possible, GPS coordinates) should also be transmitted to the palaeontologist
8) In addition to the above suggested training process of staff, a work plan must be negotiated between the contractors performing the infrastructure installation, the Amathole District Municipality (as the water services provider), and the appointed palaeontologist to determine (based on the schedule of the project) the appropriate

number and duration of site visits to ascertain if there are fossils in the excavations/cleared areas/or waste rock piles from the excavations

9) Should scientifically or culturally significant fossil material exist within the project area any negative impact upon it could be mitigated by its excavation (under permit from SAHRA) by a palaeontologist and the resultant material being lodged with an appropriately permitted institution. In the event that an excavation of the fossil material is either impossible or inappropriate the fossil or fossil locality could be protected and the site of any planned construction moved.

11.2 Reversal of Damage

Any damage to, or the destruction of, palaeontological materials or reduction of scientific value due to a loss of the original location is **irreversible**.

11.3 Irreversibility of Loss

Once a fossil is damaged, destroyed or moved from its original position without its geographical position and stratigraphic location being recorded the **damage is irreversible and total**.

Fossils are usually scarce and sporadic in their occurrence and the chances of negatively impacting on a fossil in any particular area are low. However, any fossil material that may be contained within the strata underlying the project area is potentially of the highest scientific and cultural importance. Thus, the potential always exists during construction and excavation within potentially fossiliferous rocks for the permanent and irreversible loss of extremely significant or irreplaceable fossil material. This said, many fossils are incomplete in their state of preservation or are examples of relatively common taxa. As such, just because a fossil is present it is not necessarily of great scientific value. Accordingly, not all fossils are necessarily significant culturally or scientifically significant and the potential degree of irreversible loss will vary from case to case. The judgement on the significance of the fossil must be made by an experienced palaeontologist. Thus, the potential damage to the fossils that may underlie the project area is **irreversible.** However, no fossils are expected to be impacted upon and, as such, no irreversible damage is anticipated (if the damage mitigation protocols outlined herein are enacted).

11.4 Irreplaceable loss

If the damage mitigation protocols outlined herein are enacted t it is anticipated that **the resource will not be lost.**

11.5 Mitigation potential

A Phase 2 study must be conducted by an appropriately experienced Karoo palaeontologist of the site of any excavations. As part of this study, recommendations must be made regarding damage mitigation protocols, or for the protection of the fossils.

12 ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

The bedrock of the area was variously hidden beneath an altered land surface, regolith cover, and an altered man-made infrastructure. It is a possibility that fossil-bearing strata may not be visible at the surface and during the conduct of the site visit reported upon herein.

13 ENVIRONMENTAL IMPACT STATEMENT

Amathole District Municipality (ADM), the Water Services Provider (WSP), to undertake the environmental application process for the Ngqamakhwe Phase 3 Water Supply Scheme project. It is the intention of the ADM to implement the Ngqamakhwe Regional Water Supply Scheme Phase 3 to service areas without adequate supply systems in the area. Phase 3 will include the transfer, storage, and distribution of water to the Ngqamakhwe Town Centre and 29 villages in Wards 13, 16, 18 and 20 of the Mnquma Local Municipality area in the Eastern Cape Province. The proposed development involves the implementation of a regional water supply scheme to supply potable water to the greater Ngqamakhwe area.

As the project infrastructure required for this project will be constructed upon potentially fossiliferous strata that are characterised as high sensitivity (red) within the SAHRA Palaeo-Sensitivity map a Full Palaeontological investigation of the rocks was conducted. No fossil material was located, however, given the potentially fossiliferous nature of the bedrock strata and the extensive nature of the project's footprint, it is considered possible that scientifically significant fossils of the *Lystrosaurus declivis* Assemblage Zone will be encountered and negatively impacted upon. Any negative impacts will be of unsure probability, and localised extent. Damage to fossils will be irreparable, and potentially impacting upon fossils of a highly scientifically significant fauna and flora.

A series of damage mitigation protocols are outlined herein. If these are implemented the risk of significant damage to the fossil heritage of the area will be significantly reduced. A palaeontologist must be appointed to perform a pre-arranged number of Phase 2 site investigations of all areas that will be directly affected by the proposed construction activities. That palaeontologist must then compile a report for submission to SAHRA.

14 CONDITIONS FOR INCLUSION IN AUTHORISATION

The following mitigation protocols are recommended:

1) Excavations made as part of the implementation of this project, as well as any areas cleared (e.g., the footprint of storage tanks) should be examined by a suitably experienced Karoo palaeontologist to ascertain if fossils are present.

2) However, the project has a large aerial extent, and it is expected that the installation of the infrastructure elements will occur over a protracted period of time.

3) Thus, it would not be financially viable to have a palaeontologist permanently based on site for the duration. Nor would it be financially viable to have frequent visits made,

as his would be prohibitively expensive and would only provide selected “snapshots” of the palaeontological potential of the excavations (as they will be infilled as soon as the pipelines are laid).

4) Before commencement of the project one person in the staff (e.g., site foreman, or Environmental Control Officer [ECO]) must be identified and appointed as responsible for the implementation of the damage mitigation protocol outlined herein. In instances of accidental fossil discovery this must be reported to the ECO or site manager. If the ECO or site manager is not present on site, then the responsible person on site should follow the protocol correctly in order to not jeopardize the conservation and well-being of the fossil material. It must be accepted, however, that damage or destruction may occur to fossils as they will be uncovered by industrial machinery.

5) Workmen and foremen need to be trained by the appointed palaeontologist in the procedure to follow in instances of accidental discovery of fossil material. Training via a video conference is suggested as a cost-effective methodology. A brief introduction to the process to follow in the event of possible accidental discovery of fossils should be conducted to the staff by the designated Environmental Control Officer, or the foreman or site agent in the absence of the ECO. This will allow all staff to be prepared in the event that accidental discovery of fossil material takes place.

6) Once a workman notices possible fossil material, he/she should report this to the ECO or site agent.

7) Should staff identify fossil materials work in that area should be immediately suspended, and the appointed palaeontologist immediately informed by the appointed company agent. Photographs of the fossil material (and, if possible, GPS coordinates) should also be transmitted to the palaeontologist

8) In addition to the above suggested training process of staff, a work plan must be negotiated between the contractors performing the infrastructure installation, the Amathole District Municipality (as the water services provider), and the appointed palaeontologist to determine (based on the schedule of the project) the appropriate number and duration of site visits to ascertain if there are fossils in the excavations/cleared areas/or waste rock piles from the excavations

9) Should scientifically or culturally significant fossil material exist within the project area any negative impact upon it could be mitigated by its excavation (under permit from SAHRA) by a palaeontologist and the resultant material being lodged with an appropriately permitted institution. In the event that an excavation of the fossil material is either impossible or inappropriate the fossil or fossil locality could be protected and the site of any planned construction moved.

15 CONSIDERED OPINION

If the damage mitigation protocols outlined herein are implemented, no reason could be identified for the proposed project not to proceed. Indeed, the project would provide a positive opportunity to locate fossils that may not otherwise be identified.

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5th November 2025

17 APPENDIX 1

17.1 impact Rating System

The following Impact rating System was developed in accordance with the requirements outlined in Appendix 2 of the EIA Regulations (2014, as amended). This scale takes into consideration the following variables:

- Nature: negative or positive impact on the environment.
- Type: direct, indirect and/or cumulative effect of impact on the environment.
- Significance: The criteria in Table 1 are used to determine the overall significance of an activity. The impact effect (which includes duration; extent; consequence and probability) and the reversibility/mitigation of the impact are then read off the significance matrix to determine the overall significance of the issue. The overall significance is either negative or positive and will be classified as low, moderate, or high (Table 2).
- Consequence: the consequence scale is used to objectively evaluate how severe a number of negative impacts might be on the issue under consideration, or how beneficial a number of positive impacts might be on the issue under consideration.
- Extent: the spatial scale defines the physical extent of the impact.
- Duration: the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.
- Probability: the likelihood of impacts taking place as a result of project actions arising from the various alternatives. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident) and may or may not result from the proposed development and alternatives. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.
- Reversibility: The degree to which an environment can be returned to its original/partially original state.
- Irreplaceable loss: The degree of loss which an impact may cause.
- Mitigation potential: The degree of difficulty of reversing and/or mitigating the various impacts ranges from very difficult to easily achievable. The four categories used are listed and explained in Table 6.1 below. Both the practical feasibility of the measure, the potential cost and the potential effectiveness are taken into consideration when determining the appropriate degree of difficulty.

Table 1: Ranking of evaluation criteria

Nature	
Positive	Beneficial/positive impact.
Negative	Detrimental/negative impact.
Type	
Direct	Direct interaction of an activity with the environment.
Indirect	Impacts on the environment that are not a direct result of the project or activity.
Cumulative	Impacts which may result from a combination of impacts of this project and similar related projects.
Duration	
Short term	Less than 5 years.
Medium-term	Between 5-20 years.
Long term	More than 20 years.
Permanent	Over 40 years or resulting in a permanent and lasting change that will always be there.
Extent	
Localised	Impacts affect a small area of a few hectares in extent. Often only a portion of the project area.
Study area	The proposed site and its immediate environments.
Municipal	Impacts affect the municipality or any towns within the municipality.
Regional	Impacts affect the wider district municipality or the Eastern Cape Province as a whole.
National	Impacts affect the entire country.
International/Global	Impacts affect other countries or have a global influence.
Consequence	

Slight	Slight impacts or benefits on the affected system(s) or party(ies).
Moderate	Moderate impacts or benefits on the affected system(s) or party(ies).
Severe/ Beneficial	Severe impacts or benefits on the affected system(s) or party(ies).
Probability	
Definite	More than 90% sure of a particular fact. Should have substantial supportive data.
Probable	Over 70% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Only over 40% sure of a particular fact, or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact, or of the likelihood of an impact occurring.
Reversibility	
Reversible	The activity will lead to an impact that can be reversed provided appropriate mitigation measures are implemented.
Irreversible	The activity will lead to an impact that is permanent regardless of the implementation of mitigation measures.
Irreplaceable loss	
Resource will not be lost	The resource will not be lost/destroyed provided mitigation measures are implemented.
Resource will be partly lost	The resource will be partially destroyed even though mitigation measures are implemented.
Resource will be lost	The resource will be lost despite the implementation of mitigation measures.
Mitigation potential	
Easily achievable	The impact can be easily, effectively and cost-effectively mitigated/reversed.

Achievable	The impact can be effectively mitigated/reversed without much difficulty or cost.
Difficult	The impact could be mitigated/reversed but there will be some difficulty in ensuring effectiveness and/or implementation, and significant costs.
Very Difficult	The impact could be mitigated/reversed but it would be very difficult to ensure effectiveness, technically very challenging and financially very costly.

Table 2: Description of significance ratings

Significance Rating		**Description**
LOW NEGATIVE	LOW POSITIVE	The impacts on this issue are acceptable and mitigation, whilst desirable, is not essential. The impacts on the issue by themselves are insufficient, even in combination with other low impacts, to prevent the development being approved. Impacts on this particular issue will result in either positive or negative medium to short-term effects on the social and/or natural environment.
MODERATE NEGATIVE	**MODERATE POSITIVE**	The impacts of this issue are important and require mitigation. The impacts on this issue are, by themselves, insufficient to prevent the implementation of the project, but could in conjunction with other issues with moderate impacts, prevent its implementation. Impacts on this particular issue will usually result in either a positive or negative medium to long-term effect on the social and/or natural environment.
HIGH NEGATIVE	**HIGH POSITIVE**	The impacts on this issue are serious, and if not mitigated, they may prevent the implementation of the project (if it is a negative impact). Impacts on this particular issue would be considered by society as constituting a major and usually a long-term change to the (natural and/or social) environment and will result in severe effects or if positive, substantial beneficial effects.