FULL PALAEONTOLOGICAL HERITAGE IMPACT ASSESSMENT REPORT ON THE SITE OF THE PROPOSED DEVELOPMENT OF 5 WIND TURBINES ON PORTIONS OF FARM 456 REM AND FARM 459 REM, NEAR HAGA-HAGA, EASTERN CAPE PROVINCE

18 March 2020

Prepared for:
PGS Heritage (Pty) Ltd

On behalf of:
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Prepared By:

Prof B.D. Millsteed

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EXECUTIVE SUMMARY

Wild Coast Abalone (Pty) Ltd is proposing to develop five (5) wind turbines for inhouse supply of electricity to their existing abalone farm facility. The project is located approximately 3 km north-east of Haga-Haga, Great Kei Local Municipality, Amatole District Municipality, Komga Magisterial District, Eastern Cape Province. The project area is located upon portions of the Farm 456 REM and Farm 459 REM and can be located within the confines of 1:50 000 topographic map 3228CB. The aerial extent of the project infrastructure is approximately 1 km north-west to south-east. However, the individual wind turbines will have a foot print of several square meters.

Wild Coast Abalone (Pty) Ltd has appointed CES Environmental and Social Advisory Service (Pty) Ltd to conduct the full Environmental Impact assessment (EIA), who in turn appointed PGS to do the Heritage Impact Assessment (HIA) including a Palaeontological Impact Assessment (PIA). PGS Heritage (Pty) Ltd has contracted BM Geological Services to provide a Full Palaeontological Heritage Impact Assessment Report (PIA) in respect of the proposed project that will form part of the final HIA documentation.

A comprehensive, foot-based investigation of the project site was conducted by Prof B. Millsteed on 02/03/2020. The most effective methodology for determining the fossiliferous potential of the project area was determined to be a traverse of the area by foot. Special attention was placed on the location of any bedrock outcrops that may be present within the project area. These outcrops were investigated to determine their lithology and fossil content. The path of the foot traverse was recorded as a trackway on a hand-held GPS and photographs were taken and observations made were taken at a number of locations.

The region surrounding the project area is underlain by Late Permian siliciclastic sedimentary rocks of the Adelaide Subgroup (Karoo Supergroup) and Jurassic intrusive rocks of the Karoo Dolerite Suite.

These sediments of the Adelaide Subgroup are world famous for the vertebrate fossils and plant macrofossils of the *Glossopteris* assemblage that they contain. However, the geology and biostratigraphy of the Adelaide Subgroup rocks in the eastern portion of the Eastern Cape Province in general (and the project area in specific) is not well understood. The intrusive igneous rocks of the Karoo Dolerite Suite are unfossilifeous.

Any negative impacts to the palaeontological heritage of the region will be limited to the footprint area of the construction of the project's infrastructural elements; the extent of any impact is accordingly characterised as local. Similarly, the impacts of the project should be limited to the unfossiliferous rocks of the Karoo Dolerite Suite. Any direct negative impact upon fossil materials caused by the project will be permanent (but no such impacts are anticipated). It is expected, herein, that most infrastructural elements

will only directly affect the surface of the site to a relatively shallow depth (< 2m). Indirect negative impacts will result from fossil materials that remain undiscovered after the construction of the project and which are located beneath the maximum depth of the anticipated excavations will only be negatively affected in so far as they will be unavailable for scientific study for the life expectancy of the infrastructural elements that comprise the project (i.e., long term to permanent). No negative cumulative impacts are anticipated.

No specific damage mitigation protocols are proposed herein. However, the following protocols are recommended for inclusion in the environmental authorisation. Should the excavations envisaged herein completely penetrate the Karoo Dolerite Suite rocks and expose the underlying siliciclastic rocks of the Adelaide Subgroup scientifically and/or culturally significant fossil me and/or destruction of any fossil material contained within the rock unit must be mitigated. These general mitigation protocols must be specified in the Environmental Authorisation and take the form of:

- If The sandstones and shales of the Adelaide Subgroup rocks become exposed in any excavation within the area that excavation must be halted.
- The project management must appoint a palaeontologist to evaluate the excavation for the presence of fossil material and the scientific and cultural significance of the fossil material.
- If the fossil material is assessed as being scientifically and/or culturally significant it should be excavated (under permit from SAHRA) by a palaeontologist appointed by the project management.
- The resultant excavated fossil material must be lodged with an appropriately permitted institution.
- In the event that the fossil materials excavation is impossible or inappropriate the fossil or fossil locality could be protected and the site of any planned construction moved to an alternative location.

A potential positive outcome of these mitigation protocols could be that fossil materials become available for scientific study that would otherwise have been hidden within or beneath the regolith. Should such new palaeontological material be located as a result of this site investigation this could prove to have a positive effect on the understanding of the fossil record of South Africa and positively affect the palaeontological heritage of the country.

This study has not identified any palaeontological reason to prejudice the progression of Wild Coast Abalone's wind turbine project subject to the general damage mitigation protocols outlined being implemented.

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1 INTRODUCTION

Wild Coast Abalone (Pty) Ltd is proposing to develop five (5) wind turbines for inhouse supply of electricity to their existing abalone farm facility. The project is located approximately 3 km north-east of Haga-Haga, Great Kei Local Municipality, Amatole District Municipality, Komga Magisterial District, Eastern Cape Province (Figure 1). The project area is located upon portions of the Farm 456 REM and Farm 459 REM (Figure 2) and can be located within the confines of 1:50 000 topographic map 3228CB. The centre point co-ordinates of the project area are approximately 28° 16' 3.61"E and 32° 44' 33.02"S. The aerial extent of the project infrastructure is approximately 1 km north-west to south-east. However, the individual wind turbines will have a foot print of several square meters.

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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.
- Propose 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.

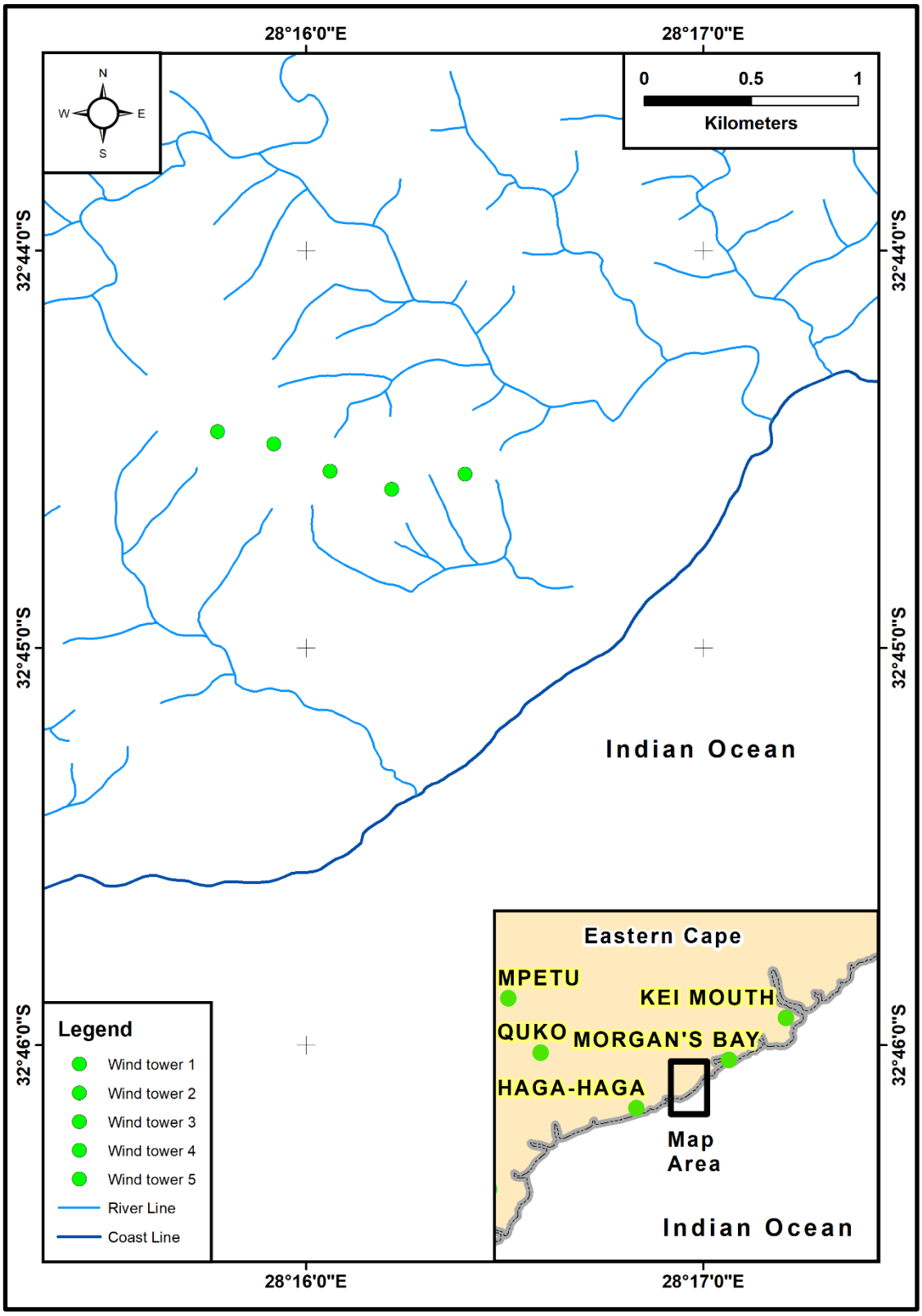

Figure 1: Location map showing the position of the proposed project.

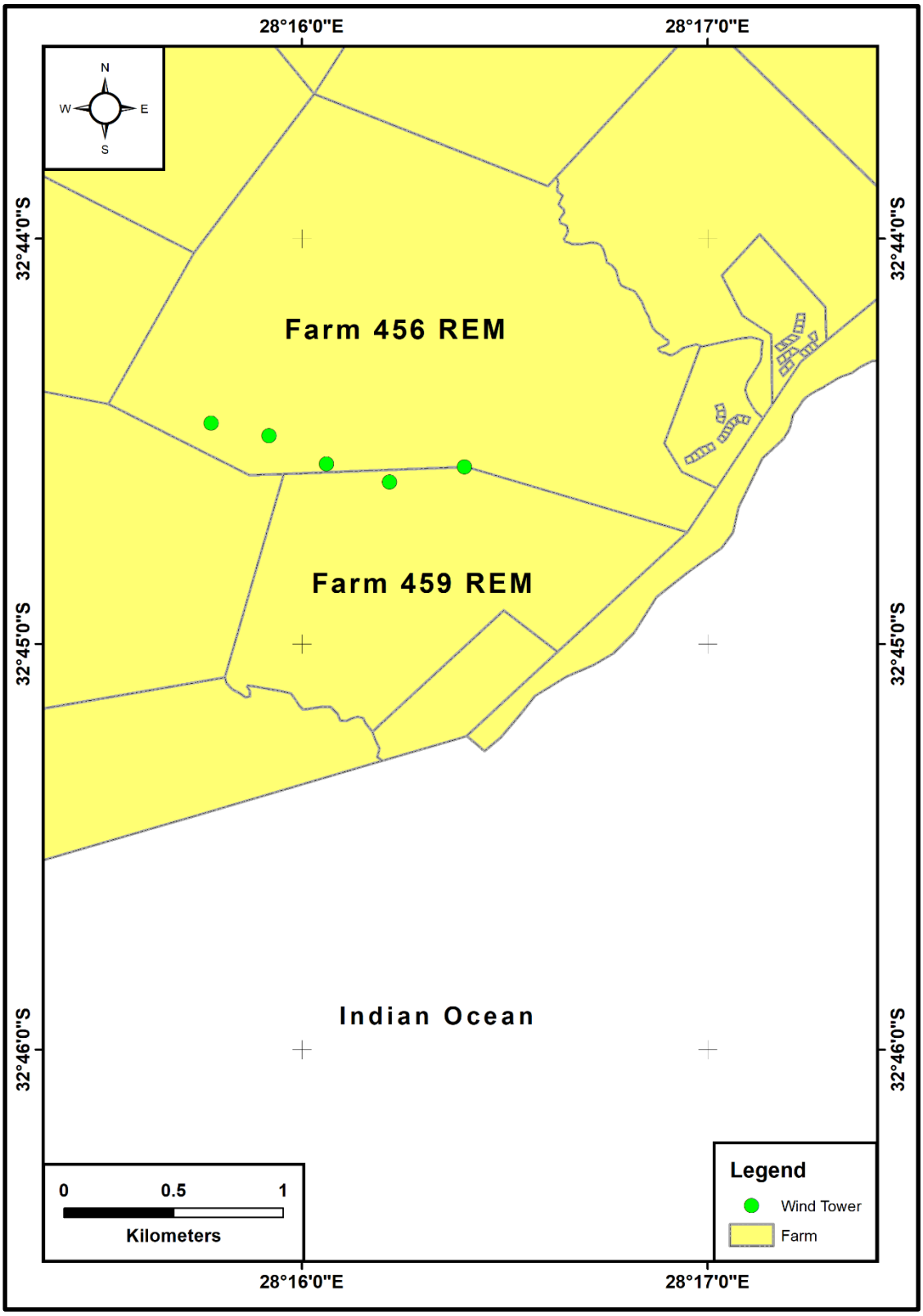

Figure 2: The location of the proposed project infrastructure relative to farm portions.

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).

3.1 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,
- Grave yards 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 which 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.).

3.2 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 300 m in length,
- The construction of a bridge or similar structure exceeding 50 m in length,
- Any development or other activity that will change the character of a site and exceed 5 000 m^2 or involve three or more existing erven or subdivisions thereof,
- Re-zoning of a site exceeding 10 000 m^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 palaeontological resources of the proposed area to be affected.

3.3 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.

3.4 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 is 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 with a view to minimising negative impacts.

In order to give effect to the general objectives of integrated environmental management outlined in the Act the potential impact on cultural heritage of activities that require authorisation or permission by law must be investigated and assessed prior to 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 METHODOLOGY

A site visit of the project area was conducted by Prof B. Millsteed on 02/03/2020. The most effective methodology for determining the fossiliferous potential of the project area was determined to be a traverse of the area by foot. Special attention was placed on the location of any bedrock outcrops that may be present within the project area. These outcrops were investigated to determine their lithology and fossil content.

The path of the foot traverse was recorded as a trackway on a hand-held GPS and is indicated in Figure 3. Photographs were taken and observations made were taken at a number of locations (see data waypoint locations in Figure 3). The location of the photographs and observation points was recorded using a hand-held GPS. Given budgetary constraints as well as the aerial extent of the proposed development it was impossible to visit every bedrock exposure within the project site within an acceptable timeframe. It was indicated to Prof Millsteed that the outcomes of the various specialist studies being undertaken may necessitate the eventual placement of any of the wind turbines to nearby sites other than that currently planned. It was considered, herein, that the appropriate approach would be to conduct a survey of the general area planned for the development of the turbines rather than being limited to the five planned sites. This approach would allow for the identification of "no go" zones as well as a larger area where placement of the turbines would have limited or no impact.

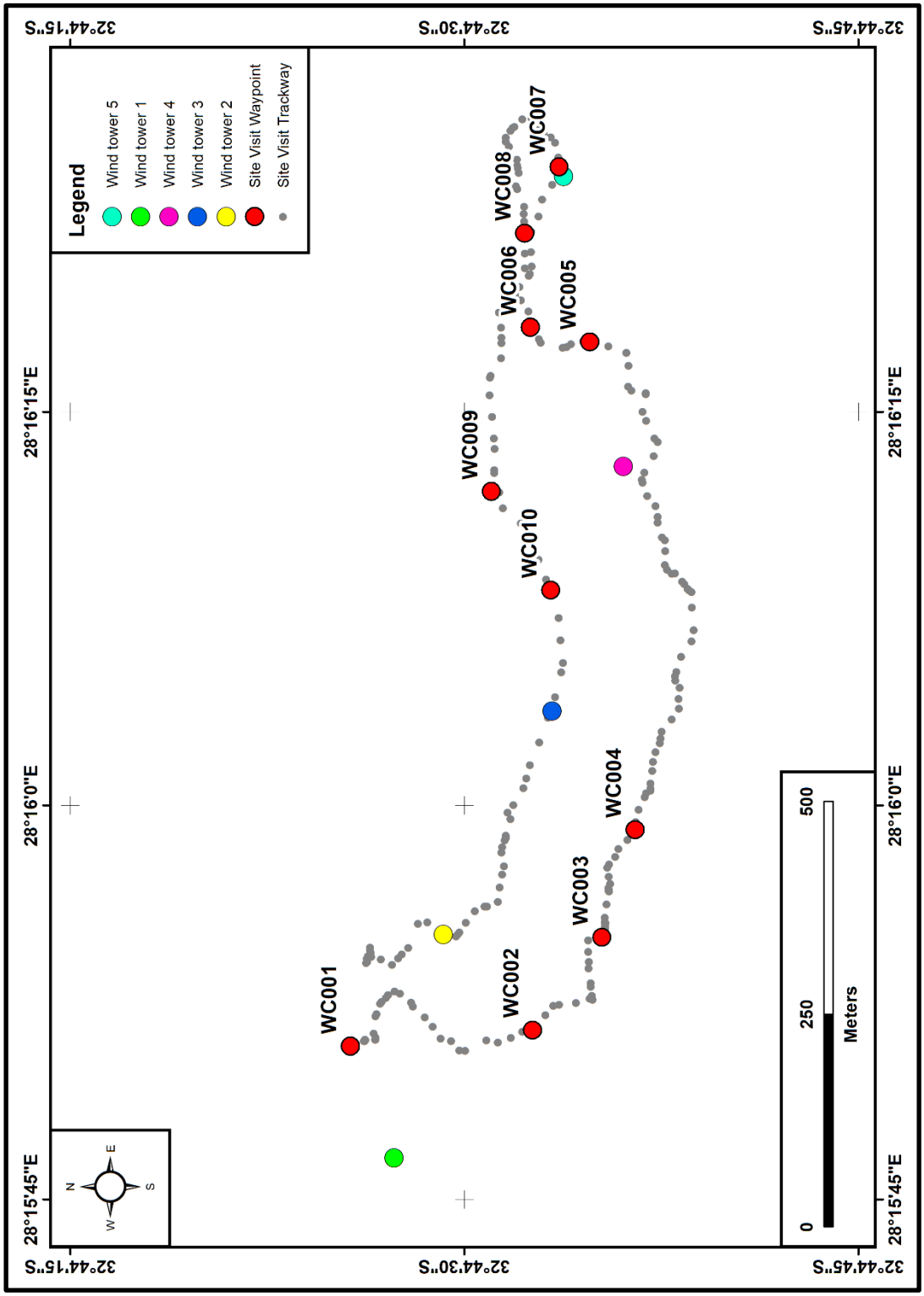

Figure 3: Map showing the location of the GPs trackway representing the location of the foot traverse conducted across the project area as well as the location of waypoints at which data was collected. Shown also is the approximate location of pre-existing powerlines that were emplaced to provide power to the project infrastructure.

5 RELEVENT 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 principle of BM Geological Services 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 African, a member of the Association of Australasian Palaeontologists and is a Fellow of the Geological Society of South Africa.

6 ACCESS AND INDEPENDENCE

The area to be impacted by the proposed construction of the wind turbine project was identified by Mr R. Clark [Managing Director, Wild Coast Abalone (Pty) Ltd] prior to the conduct of the site visit. The research was conducted completely free of any hindrance and, indeed, every help and assistance was provided. 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. The land surface is located upon the crest and margins of a prominent ridge that is vegetated with grass cover and extensive thickets of brush. As the observations were conducted on foot there were no areas that could not be easily visited and studied.

7 GEOLOGY AND FOSSIL POTENTIAL

Figure 4 shows that the region surrounding the project area is underlain by Late Permian siliciclastic sedimentary rocks of the Adelaide Subgroup (Karoo Supergroup) and Jurassic intrusive rocks of the Karoo Dolerite Suite. A brief description of the geology of the Adelaide Subgroup and Karoo Dolerite Suite and their potential palaeontological content follows.

6.1 Adelaide Subgroup

6.1.1 Geology

The project area is underlain by Late Permian sedimentary rocks of the Adelaide Subgroup, Beaufort Group (Figures 4). In the southern and central portions of the Main Karoo Basin the Adelaide Subgroup is differentiated into two distinct stratigraphic

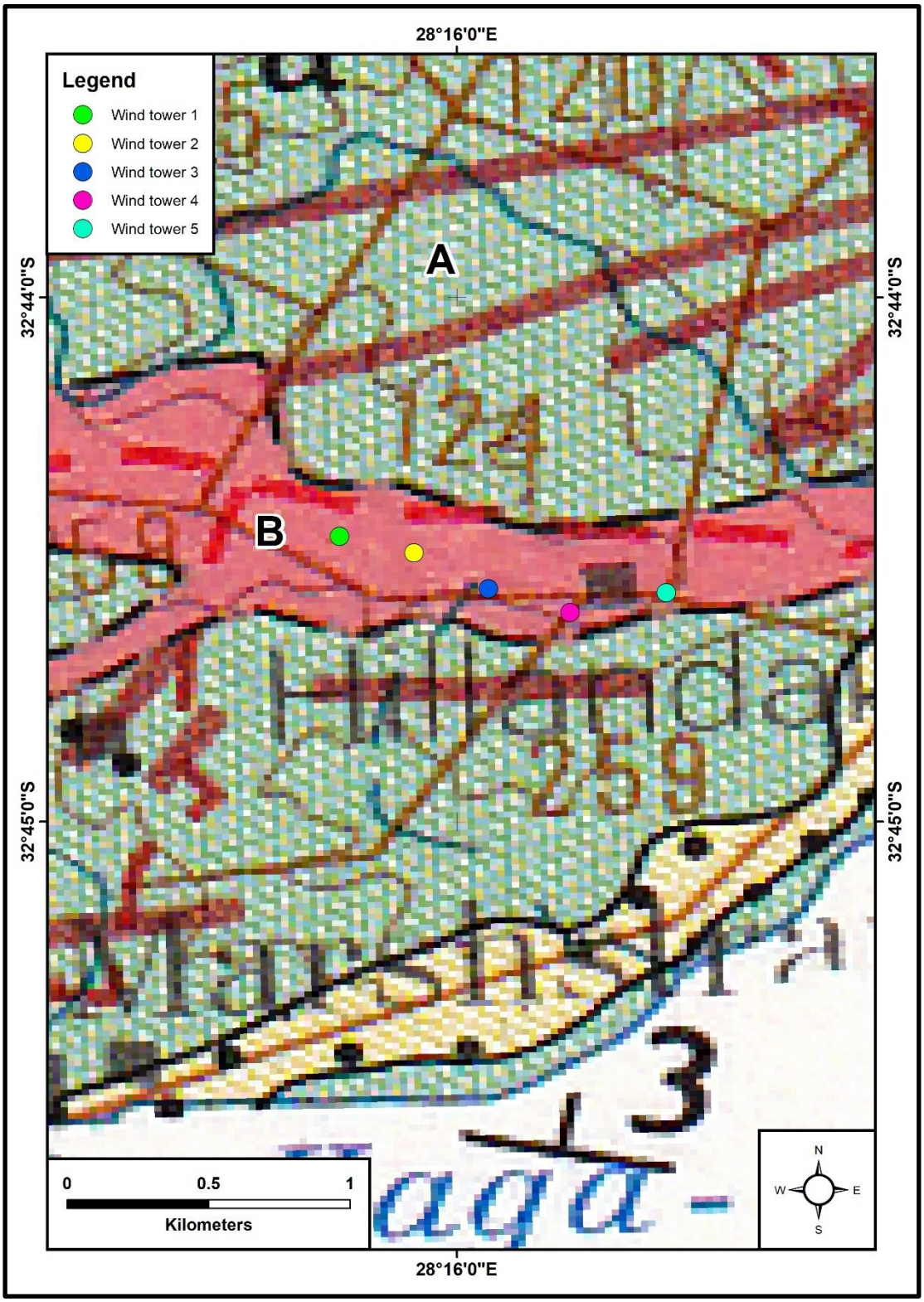

Figure 4: Geological map of the area underlying the proposed project infrastructure and the surrounding environs. The stratigraphic unit marked "A" is the Adelaide Subgroup while the unit marked "B" is the Karoo Dolerite Suite (Modified from Geological Survey of South Africa, 1979).

sequences which are located either side of the line of longitude of 24° east. To the east of that dividing line the Adelaide Subgroup consists of (in order of decreasing stratigraphic age) the Koonap, Middelton and Balfour Formations. To the west of 24° east the Adelaide Subgroup is subdivided into a lower Abrahamskraal and an upper Teekloof Formations. In the northern and north-eastern region of the basin (which contains the project area) only a single formation, the Normandien Formation, is present (Groenewald, 1984, 1990).

In general, the Adelaide Subgroup consists of alternating bluish-grey, greenish-grey or greyish-red mudrocks and grey, very fine- to medium-grained lithofeldspathic sandstones (South African Committee for Stratigraphy, 1980). Sandstones generally constitute 20-30% of the total thickness of the sequence, but maybe as high as 60% and as low as 10%. Deposition within the northern part of the basin varies from that in the remainder of the basin in that coarse- to very coarse-grained sandstones or even granulestones are common within the Normandien Formation and the mudstones of the Adelaide Subgroup are generally massive and blocky weathering except in parts of the Normandien Formation and Daggaboersnek Member where horizontal lamination is common and rhythmites are common (Johnson *et al*., 2006). The sediments of the Normandien Formation are further differentiated from the remainder of the Adelaide Subgroup in that thin coal beds are occasionally present in the lower part (Botha and Linstrőm, 1984; Groenewald, 1984). Historically the lower 200 m – 450 m of lacustrine and deltaic sediments of the Adelaide Subgroup in the north-east of the basin was termed the Estcourt Formation.

Genetically the Normandien Formation differs from coeval strata in the southern and central portions of the Karoo Basin in that deposition took place within more southerly oriented depositional systems rather than the west-north-westerly fluvial transport systems exhibited in the south (Cole and Wipplinger, 2001). The depositional system was initially lacustrine and deltaic with progradation to the east and changed upwards into fluvial meandering under drier conditions (Cole and Wipplinger, 2001).

7.1.1 Palaeontological potential

Figure 5 indicates that the project area lies within a region of the extent of the Adelaide Subgroup that is poorly known palaeontologically. The reason for the paucity of knowledge in this region lies in a combination of the thick vegetation cover and generally thick and pervasive nature of the regolith cover in the region. The rocks of the Adelaide Subgroup are famous for the fossil fauna of vertebrate fossils they contain. As stated above, the palaeontology of this region of the Adelaide Subgroup is poorly understood. Thus, it may be possible that rocks underlying the project area may fall within any of the *Eodicynodon*-, *Tapinocephalus*-, *Pristerognathus*-, *Tropidostoma*-, *Cistecephalus*-, or *Dicynodon* Assemblage Zones. As such, the rocks underlying the project area may be reasonably expected to contain a rich and diverse fauna of reptiles, mammal-like

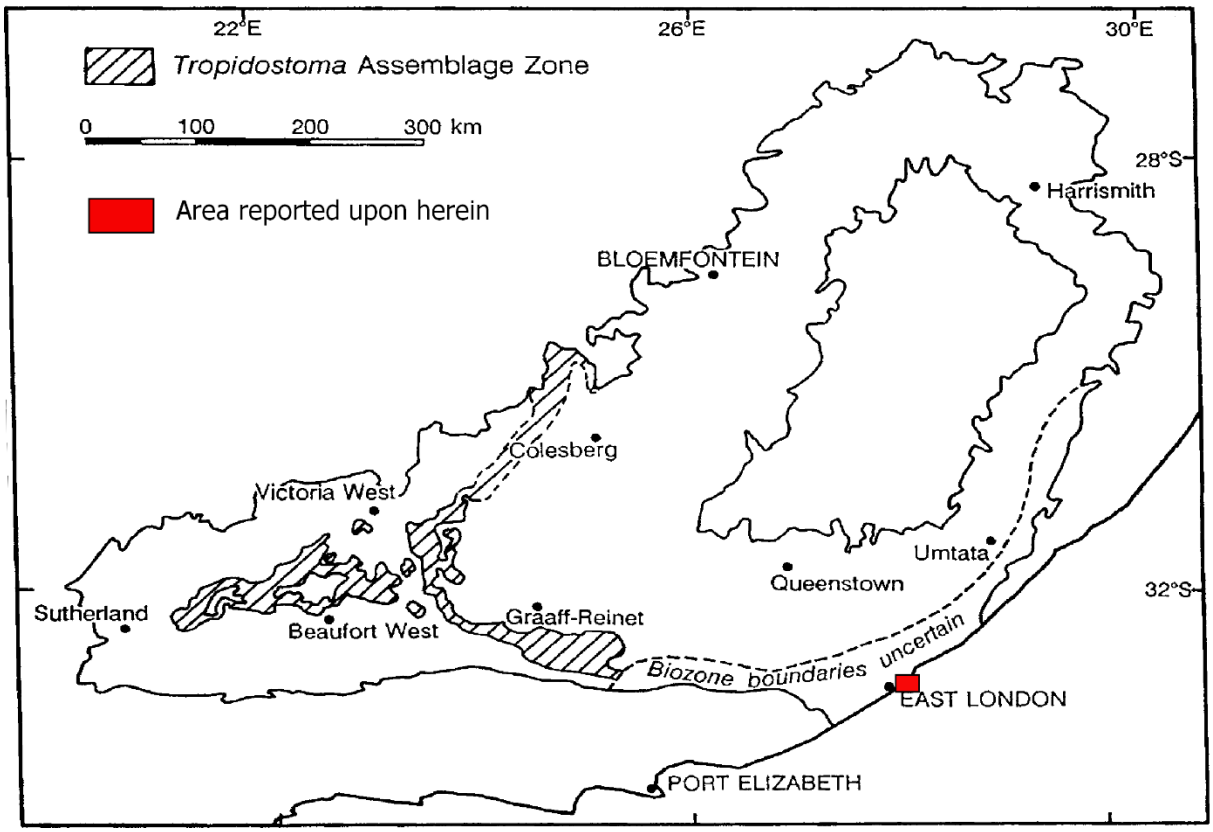

Figure 5: The distribution of the *Tropidostoma* Assemblage Zone in South Africa. The *Tropidostoma* Assemblage Zone is one of the vertebrate biostratigraphic zones that may be present in the rocks underlying the project area. It is evident from the diagram that the status of the vertebrate-based biostratigraphy in the rocks underlying the project area is uncertain (Modified from Smith and Keyser, 1995).

reptiles, and amphibians. The taxa present will be dependent upon the particular assemblage zone(s) that are represented. A description of the composition of each assemblage zone is contained within the various sections of Rubidge (1995).

The Adelaide Subgroup is also well-known for the plant macrofossils (leaves and fructification) of the *Glossopteris* flora that it contains. It may be expected that this sequence may also contain plant fossils (including silicified wood) belonging to the *Glossopteris* flora (Johnson *et al*., 2006). Bamford (2004) indicates that this sequence contains the fossil wood genera *Agathoxylon* and *Australoxylon*.

7.2 Karoo Dolerite Suite

7.2.1 Geology

The geological map of the region (Figure 4) 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 indicates that the majority of the project area is underlain by dolerite. The site investigation has confirmed the presence of dolerite (Figures 6-7), and that the entire project area bears a dark brown regolith derived from weathering of the dolerite (Figure 7). The dolerite forms the capping strata of an elevated, mildly incised plateau that dominated the topography of the region west of the project area.

6.1.2 Palaeontological potential

The rocks comprising the Karoo Dolerite Suite are hypabyssal (intrusive igneous) dolerites. Their genesis lies in the intrusion at depth within the earth's crust as magma, and subsequent cooling and crystallisation. The combination of these factors precludes the presence of fossils within the lithology. As such, the fossiliferous potential of the unit is **nil**.

8 ENVIRONMENT OF THE PROPOSED PROJECT SITE

Inspection of Figure 8 indicates that the project area lies upon the eastern margin of a relatively undulating, relatively featureless plateau. The five wind turbine towers are planned to be located at the break in slope of a and proximal to a steep slope. The site overlooks a narrow coastal plain upon which the exiting Wild Coast Abalone (Pty) Ltd facility is located.

Mucina and Rutherford (2006) indicate that the project area is vegetated with a cover of the Albany Coastal Belt vegetation type (Figure 9) and they further state that the conservation status of the vegetation type is listed as least threatened. It was observed during the site visit that much of the area remains vegetated with thick scrub thickets, although significant areas appear to have been historically cleared and are now vegetated with rank grassland.

Inspection of Google earth imagery (Figure 10) reveals that the dirt road to Fish Bay lies parallel- and extremely proximal-to the project infrastructure. A small dwelling and associated out houses also lies immediately north of proposed wind turbine 4. It was apparent during the site visit that the are is currently utilised for cattle grazing. It also forms part of a conservancy area and is stocked with various game species.

Figure 6: Rounded outcrops of dolerite. The note book used for scale is A5 (Waypoint WC 003; see Figure 3).

Figure 7: Low, rounded dolerite outcrop. Note the dark brown, clay rich regolith surrounding the outcrop is derived from weathering of the dolerite and is visible across the entire area investigated (Waypoint WC 004; see Figure 3).

9 OVERVIEW OF SCOPE OF THE PROJECT

Wild Coast Abalone (Pty) Ltd wishes to construct five (5) wind turbines for the purpose of supplementing electrical power supply to their existing abalone farm facility. Wind turbines towers 1-3 are proposed to be located along the southern margin of Farm 456 REM and towers 4-5 will be located along the northern margin of Farm 459 REM. It is anticipated that the emplacement of the required project infrastructure will require the following elements:

It is anticipated, for the purposes of this report, that the emplacement of these above infrastructure elements the following impacts will be made upon the land surface and bedrock:

- Clearing and levelling of the land surface at the location of each turbine tower.
- Emplacement of twin spoor roads connecting the location of towers to the fish Bay road.
- Excavation of trenches to accommodate wind turbine foundations.
- Excavation of trenches to accommodate powerlines to a power substation.

It is anticipated that the maximum depth of any negative impacts upon the land surface and bedrock will be <2 m.

9.1 Impact upon the bedrock geology

Rocks of the Adelaide Subgroup and the Karoo Dolerite Suite underlie the proposed location of the wind turbines and the surrounding environs. It is only the rocks of the Karoo Dolerite Suite that constitute the land surface at each of the wind tower locations. The thickness of the dolerite in the project area is much greater than the anticipated 2 m maximum depth of impact of any disturbance of the land surface. Accordingly, it is only the rocks of the Karoo Dolerite Suite that will be impacted upon by the development of the project.

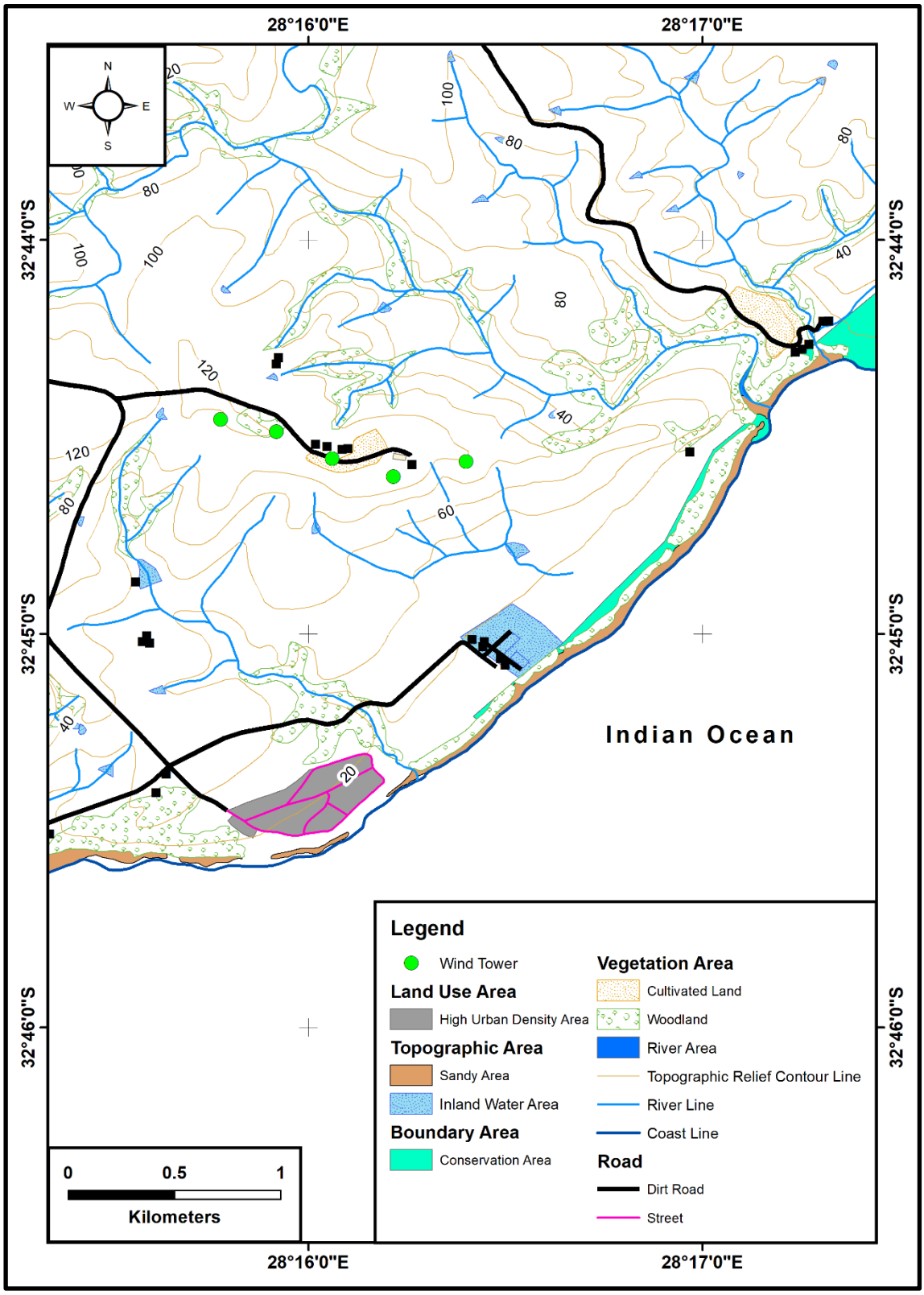

Figure 8: Topographic map of the project area with topographic contours superimposed. The contour interval of the topographic contours is 20 m.

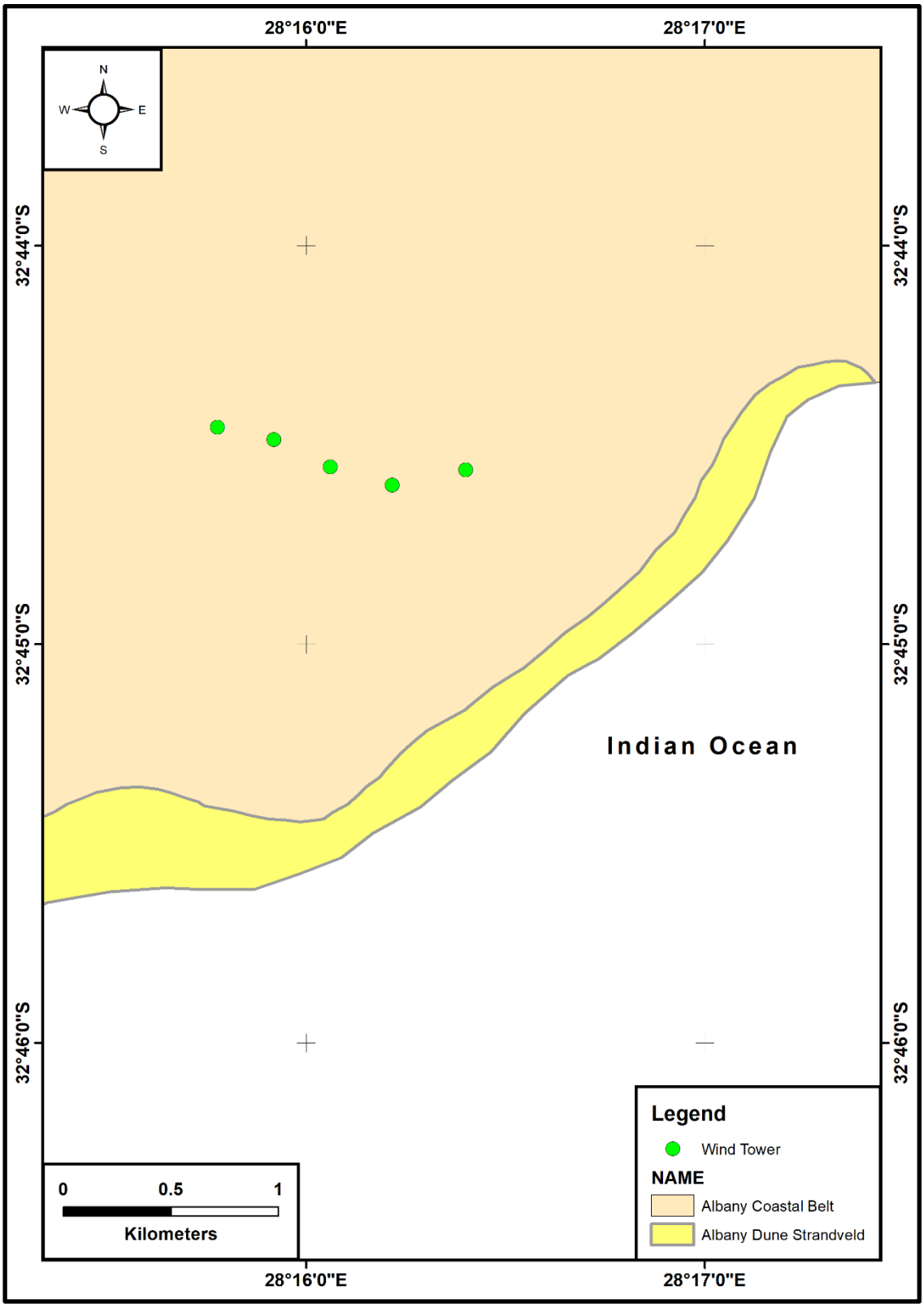

Figure 9: Map of the distribution of the vegetation veld types located within the project area and the surrounding environs (after Mucina and Rutherford, 2006).

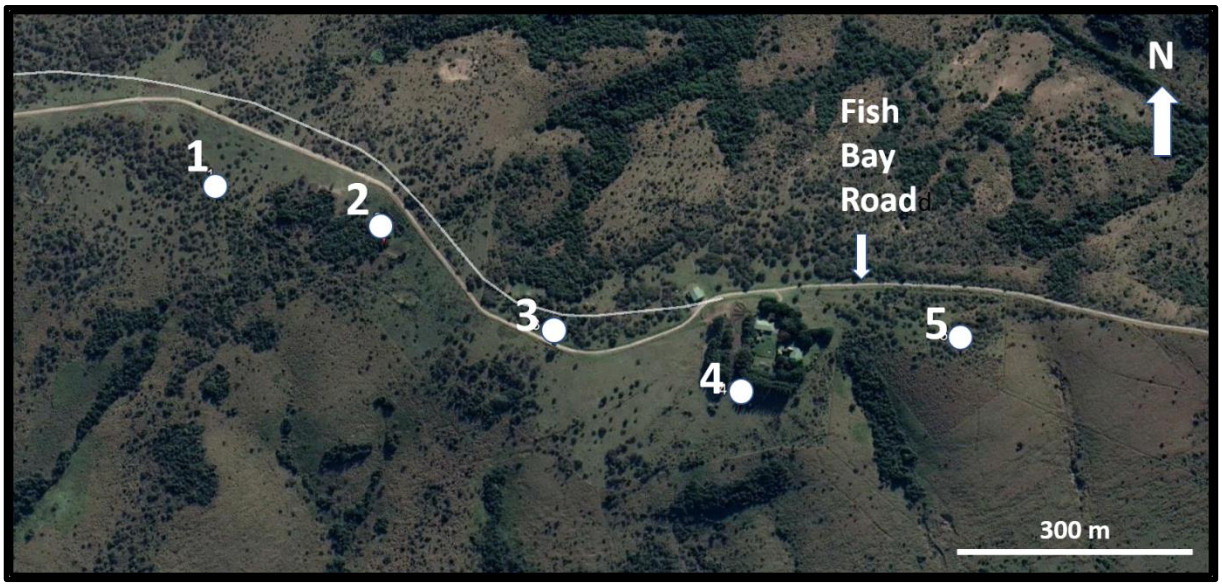

Figure 10: Google earth image of the area of the proposed wind turbines (white circles numbered 1-5) and the surrounding environs. Access to the site is via the Fish Bay road.

10 IMPACT ASSESSMENT

The potential impact of the expansion of Wild Coast Abalone (Pty) Ltd's abalone wind turbine project is categorised below according to the following criteria:-

10.1 Nature

The impacts of the project upon the palaeontological heritage of the Karoo Dolerite Suite is nil, as the unit is unfossiliferous. The rocks of the Adelaide Subgroup underly the Karoo Dolerite Suite and are known to contain fossil faunas and floras of world importance. However, these rocks were not found to crop out within the area to be impacted upon directly by the construction of the project's infrastructure. However, should the estimates of the thickness of the Karoo Dolerite Suite herein prove to be an underestimate (or the depth of excavation required for the foundations of the wind turbine towers prove greater than estimated) there is a possibility that the excavations may expose Adelaide Subgroup rocks. Should this occur and the rock strata prove fossiliferous this would prove highly beneficial to science. In this eventuality the nature of the project is considered to be of **beneficial/positive impact**.

10.2 Type of Impact

10.2.1 Direct

The direct impacts upon 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 to 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 projects 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 completely destroy their scientific significance.

It is considered, herein, that only the rocks of the karoo Dolerite Suite will be directly impacted upon by the project.

10.2.2 Indirect

The indirect impacts upon the palaeontological heritage of the project area 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 those constructions and facilities. The emplacement of the wind turbine towers will directly impact upon the Karoo Dolerite Suite. The indirect impacts of the progression of the project will be that the rocks of the Adelaide Subgroup will be effectively sterilised from scientific investigation for the life-time of the turbine towers.

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 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 life style 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. Obviously, 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. Clearly, 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 a 12-month period); animal 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 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 it is possible to make the observation that the Karoo Dolerite Suite is unfossiliferous. Accordingly, there would be nothing in the form of regional negative impacts upon the palaeontological heritage of the unit resulting from this project. The potential for the project to add significantly to negative impacts upon the palaeontological heritage of the wider region must be assessed as having a **nil cumulative impact**.

10.3 Duration of Impact

The anticipated duration of the identified potential impact is assessed as potentially **permanent**. This is assessment is based on the fact that, in the absence of mitigation procedures (should fossil material be present within the area to be affected) the damage or destruction of any palaeontological materials will be permanent. Similarly, any fossil materials that exist below the structures and infrastructural elements that will constitute the wind turbine project will be (i.e., > 40 years in duration) unavailable for scientific study for the life of the existence of those features. The life of the project infrastructure is expected to be permanent to long term herein.

10.4 Extent of Impact

The possible extent of the permanent impact of the proposed project on the palaeontological heritage of South Africa is restricted to the damage, destruction or accidental relocation of fossil material caused by the excavations and construction of the necessary infrastructure elements forming part of the project. The possible source of a less permanent negative impact on the palaeontological heritage is the loss of access for scientific research to any fossil materials that become covered by the various infrastructural elements that comprise the project. The extent of the area of potential impact is, accordingly, categorised as **localised** (i.e., restricted to the location of the project infrastructure).

10.1 Significance of the Impact

The siliciclastic sediments of the Adelaide Subgroup are world famous for the rich and varied fauna of fossil vertebrates it contains as well as a more depauperate, but equally scientifically important fossil macroflora of the *Glossopteris* flora. Apart from the world significance of the fossils that are known to occur in this rock unit, any fossils contained in the rocks underlying the project area will be of even greater significance due to the extremely poor state of knowledge of the fossil floras and faunas in this region of the Eastern Cape Province. The discovery and scientific study of any fossils occurring in this region will potentially greatly advance the level of scientific understanding of the lithostratigraophic and biostratigraphic subdivision of the Adelaide Subgroup rocks in the eastern portion of the province.

However, it is not considered likely that this unit will only be indirectly impacted upon by this project. Mitigating facts that soften the significance of these indirect impacts is that the Adelaide Subgroup rocks lie beneath a thick cover of Karoo Dolerite Suite rocks and, as such, are currently unavailable for scientific study. Similarly, the extreme cost of removal of the dolerite to expose the underlying Adelaide Subgroup makes such an undertaking extremely unlikely to be undertaken by a palaeontologist. The potentially

fossiliferous rocks of the Adelaide subgroup will accordingly remain unavailable for scientific study until exposed by erosion. The time span involved in this natural process geologically long, and will be considerably longer than the life span of the wind turbines. The indirect consequences upon the palaeontological heritage of the Adelaide Subgroup are assessed as being **low negative**.

The Karoo Dolerite Suite will be directly impacted upon, but they are unfossiliferous. As such, the project's impacts upon the palaeontological heritage of the rock unit and the region will be nil (**low negative**).

The scientific and cultural significance of fossil materials is underscored by the fact that 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 to 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 project infrastructural elements the result will potentially be the irreversible damage or destruction of the fossil(s).

The certainty of the exact *in situ* location of fossils and their precise location within the stratigraphic sequence is essential to the scientific value of fossils. The movement of any fossil material during the construction of the facility that results in the exact original location of the fossil becoming unknown will either greatly diminish or destroy the scientific value of the fossil.

10.2 Consequence

There are nil consequences anticipated from of the impacts resulting from the project as the rock unit impacted upon is unfossiliferous. The consequences of the project are characterised as being **slight** [i.e., slight impacts or benefits on the affected system(s) or party(ies)].

10.3 Probability of Impact

It is pertinent to realise that fossils are generally scarce and sporadic in their occurrence and, as such, the probability of any development affecting a fossil at any particular point on the land surface in relatively low. The rocks of the Karoo Dolerite Suite are known to be unfossiliferous and it has been ascertained during the site visit that these will be the only rocks affected by the project. As such the probability of fossil materials being negatively impacted upon by this project is nil. The probability of nil impact resulting from this project is characterized according to the impact assessment being used in this report as being **definite**.

11 DAMAGE MITIGATION, REVERSAL AND POTENTIAL IRREVERSABLE 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

No fossil material were identified during the progress of the site investigation that underpins this report. The only lithological unit that will be directly impacted upon by this project is considered to be unfossiliferous. Accordingly, no damage mitigation protocols are required to preserve fossil assemblages.

Should scientifically or culturally significant fossil material exist within the project area, and these are discovered during the emplacement of the project's infrastructure elements, any negative impact upon it should be mitigated. This mitigation should take the form its evaluation by a palaeontologist and if considered scientifically significant it should be excavated (under permit from SAHRA) by a palaeontologist and the resultant material being lodged with an appropriately permitted institution. In the event that the fossil materials excavation is 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 necessary significant culturally of 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 underly the project area is **irreversible.**

11.4 Irreplaceable loss

The irreplaceable loss of fossil materials resulting from this project is assessed as being at a level where **the resource will not be lost**.

11.5 Mitigation potential

No damage mitigation protocols will be required for the implementation of this project. As such, the mitigation potential is assessed as being **easily achievable**.

12 ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

Fossils occur sporadically within geological units and their location cannot be accurately predetermined. Despite a comprehensive investigation of the project areas by foot it was impractical (within time and budgetary constraints) to visit all locations with the confines of the infrastructure that will comprise the wind turbine project. In addition, the vast majority of the bedrock of the area was hidden beneath thick vegetation and regolith cover. It is a possibility that rocks of the Adelaide Subgroup may be present in areas that will be directly impacted upon by the project, but were not identified during the site visit.

13 ENVIRONMENTAL IMPACT STATEMENT

A comprehensive, foot-based investigation of the palaeontological potential of the proposed wind turbine project was conducted by Prof Barry Millsteed on 02/03/2020. The aerial extent of the project infrastructure is approximately 1 km north-west to south-east. However, the individual wind turbines will have a foot print of several square meters and a maximum depth of excavation of < 2 m.

The project is completely underlain by siliciclastic sediments of the Adelaide Subgroup and intrusive igneous rocks of the Karoo Dolerite Suite. The rocks of the Adelaide Subgroup are known to contain fossil vertebrate faunas and plant macrofossil assemblages of world importance. The importance of the fossils that may occur within this unit within the project area is further amplifies due to the extremely poor state of knowledge about the lithostratigraphy and biostratigraphy of the unit in the eastern portion of the Eastern Cape Province. Any new information obtained in this area would be of extreme importance to the understanding of this portion of South Africa's geology.

However, this rock unit will only be indirectly impacted upon by the project and that impact is of no scientific significance.

The strata comprising the Karoo Dolerite Suite will be directly impacted upon by the project. However, these rocks are unfossiliferous. Any negative impacts upon the rock strata of this unit will not translate to a negative impact upon the palaeontological heritage of South Africa.

Any negative impacts to the palaeontological heritage of the region will be limited to the footprint area of the project's infrastructural elements; the extent of any impact is accordingly characterised as localised. Any negative impact upon fossil materials caused by the project will be permanent. It is anticipated, herein, that most infrastructural elements will only directly affect the surface of the site to a relatively shallow depth (< 2m). Fossil materials that remain undiscovered after the construction of the project and which are located beneath the maximum depth of the anticipated excavations will only be indirectly negatively affected in so far as they will be unavailable for scientific study for the life expectancy of the infrastructural elements that comprise the project (i.e., long term to permanent). However, they would not have been available for scientific study and the consequences of this impact are not significant.

No specific damage mitigation protocols are determined to be necessary or are required to be recommended to be emplaced either prior to or coevally with the construction of the project's infrastructure. However, the geology of the area does not crop out extensively, and the possibility remains that fossiliferous bedrock may be impacted when construction commences. A series of damage mitigation protocols are outlined in Section 14 for inclusion in the Environmental Authorisation in case fossil materials are identified during the construction phase. A potential positive outcome of these mitigation protocols could be that fossil materials become available for scientific study that would otherwise have been hidden within or beneath the regolith. Should such new palaeontological material be located as a result of this site investigation this could prove to have a decidedly positive effect on the understanding of the fossil record of South Africa and positively affect the palaeontological heritage of the country.

14 CONDITIONS FOR INCLUSION IN AUTHORISATION

Should the excavations envisaged herein completely penetrate the Karoo Dolerite Suite rocks and expose the underlying siliciclastic rocks of the Adelaide Subgroup scientifically and/or culturally significant fossil me and/or destruction of any fossil material contained within the rock unit must be mitigated. This mitigation must be specified in the Environmental Authorisation and take the form of:

- If The sandstones and shales of the Adelaide Subgroup rocks become exposed in any excavation within the area that excavation must be halted.

- The project management must appoint a palaeontologist to evaluate the excavation for the presence of fossil material and the scientific and cultural significance of the fossil material.
- If the fossil material is assessed as being scientifically and/or culturally significant it should be excavated (under permit from SAHRA) by a palaeontologist appointed by the project management.
- The resultant excavated fossil material must be lodged with an appropriately permitted institution.
- In the event that the fossil materials excavation is impossible or inappropriate the fossil or fossil locality could be protected and the site of any planned construction moved to an alternative location.

15 CONSIDERED OPINION

This study has not identified any palaeontological reason to prejudice the progression of Wild Coast Abalone's wind turbine project subject to the general damage mitigation protocols outlined herein being implemented.

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Prof B.D. Millsteed

18th March 2020

17 APPENDIX 1

17.1 impact Rating System

The following Impact rating System was supplied by PGS Heritage and 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 9.1 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 in order 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 9.2).
- Consequence: the consequence scale is used in order 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 is 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 difficultly 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 on 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.