HERITAGE IMPACT ASSESSMENT: HIGHLANDS WIND ENERGY FACILITY AND ASSOCIATED GRID CONNECTIONS, SOMERSET EAST MAGISTERIAL DISTRICT, EASTERN CAPE

Required under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999).

SAHRIS Case Nos.:
Wind Energy Facilities: Phase 1 - 12637, Phase 2 - 12638, Phase 3 - 12639
Grid connections: Phase 1 -12640, Phase 2 - 12641, Phase 3 - 12643

Report for:

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EXECUTIVE SUMMARY

ASHA Consulting (Pty) Ltd was appointed by Arcus Consultancy Services (Pty) Ltd to compile a heritage impact assessment for the proposed Highlands Wind Energy Facilities (WEF) close to Somerset East in the Eastern Cape Province. The project will be split into three phases and will require three grid connections. In total six Environmental Authorisations are being sought. The site lies within a Renewable Energy Development Zone (REDZ) and all projects will follow Basic Assessment processes.

The site is comprised of rolling, grass-covered hills with a number of river valleys in between them. Bedrock occasionally crops out at the surface but is generally rare. Taller vegetation on the hills includes occasional trees and many prickly pears. The river valleys are more densely vegetated. Farm access roads are present throughout the area. The development would focus on the high-lying ground and would not affect the valleys except occasional places where roads and/or powerlines may need to cross them.

Heritage resources were present throughout the study area but were generally sparsely distributed. The vast majority were archaeological in nature and consisted of Early and Middle Stone Age stone artefacts, generally in eroding contexts on exposed hillsides. Later Stone Age material in better context tends to be focused on the river valleys. Historical farm complexes and other historical traces are also focused on valleys. The landscape has cultural significance both for its historical value and its aesthetic qualities. The aesthetic qualities render the R63 a scenic route.

Impacts to palaeontological resources will certainly occur, but in general the fossils recorded in the study area are of low cultural significance and those few important locations discovered do not fall within the proposed WEF layouts. One such area does fall within the Alternative 2 power line alignment for the Highlands North grid connection. Impacts to archaeological resources will very likely occur but all affected resources are expected to be of relatively low cultural significance with the result that mitigation could be very easily effected for any sites that cannot be avoided. Graves and historical structures tend to be located within valleys and should not be affected. The only other consideration is the cultural landscape. It has both historical and aesthetic value but, being located in a Renewable Energy Development Zone (REDZ) suggests that a new electrical layer is expected to be added to the landscape. Effective mitigation cannot be achieved for this aspect due to the size of the turbines but basic measures to reduce landscape scarring will help reduce the overall severity of the impacts.

It is recommended that the all three proposed WEFs and all three proposed power lines (using any alternatives) be allowed to proceed but subject to the following conditions which should be incorporated into the environmental authorisation of each of the six projects as appropriate:

- Monitoring of all substantial excavations (e.g. wind turbine foundations) for fossil material on an on-going basis during construction phase;
- Application of Chance Fossil Finds Procedure (See Appendix 2 of palaeontological specialist study): safeguarding new fossil finds and reporting to ECPHRA by ECO for possible recording and sampling by professional palaeontologist;
- The access road via Farm 105/rem must not be used;
- The large valley on Farm 105/1 must be avoided; especially the archaeological site between waypoints 1781, 1793 and 1796;

- A minimum 30 m buffer to be maintained around all graves, ruins and buildings (but note possible exception in next recommendation);
- If the internal road alignment through the waypoints 1751-1758 area is used then the various heritage features there are to be cordoned off for their protection with the largest buffers possible and waypoint 1754 will require archaeological excavation work to sample and record the historical midden (Highlands Central Phase 2);
- The fence incorporating historical stone fence posts (waypoint 1720 lies on this fence line) should be avoided if possible (Highlands North Phase 1 and Central Phase 2);
- A final walk-down survey of the authorised footprints and alignments for all six projects should be carried out at least 6 months before the start of construction in order for any archaeological mitigation requirements to be determined and carried out;
- If any archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

Glossary

Background scatter: Artefacts whose spatial position is conditioned more by natural forces than by human agency

Early Stone Age: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.

Handaxe: A bifacially flaked, pointed stone tool type typical of the Early Stone Age.

Holocene: The geological period spanning the last approximately 10-12 000 years.

Hominid: a group consisting of all modern and extinct great apes (i.e. gorillas, chimpanzees, orangutans and humans) and their ancestors.

Hominin: a smaller group consisting of modern humans, extinct species of humans and all their immediate ancestors.

Later Stone Age: Period of the Stone Age extending over the last approximately 20 000 years.

Middle Stone Age: Period of the Stone Age extending approximately between 200 000 and 20 000 years ago.

Pleistocene: The geological period beginning approximately 2.5 million years ago and preceding the Holocene.

Abbreviations

APHP: Association of Professional Heritage Practitioners

ASAPA: Association of Southern African Professional Archaeologists

BAR: Basic Assessment Report

CRB: Central Road Board

CRM: Cultural Resources Management

DEA: Department of Environmental Affairs

ECO: Environmental Control Officer

ECPHRA: Eastern Cape Provincial Heritage Resources Authority

EIA: Environmental Impact Assessment

ESA: Early Stone Age

GPS: global positioning system

HIA: Heritage Impact Assessment

LSA: Later Stone Age

MSA: Middle Stone Age

NEMA: National Environmental Management Act (No. 107 of 1998)

NHRA: National Heritage Resources Act (No. 25) of 1999

REIPPP: Renewable Energy Independent Power Producers Programme

PPP: Public Participation Process

REDZ: Renewable Energy Development Zone

SAHRA: South African Heritage Resources Agency

SAHRIS: South African Heritage Resources Information System

WEF: Wind Energy Facility

WKN-WC: WKN Windcurrent

CONTENTS OF THE SPECIALIST REPORT – CHECKLIST

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	Section of Report
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	**1.4 & Appendix 1**
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	**Appendix 2**
(c) an indication of the scope of, and the purpose for which, the report was prepared;	**1.3**
(cA) an indication of the quality and age of base data used for the specialist report;	**n/a**
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	**7.3 & 8.5**
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**3.2**
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	**3**
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	**1.1.2**
(g) an identification of any areas to be avoided, including buffers;	**11**
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	**Appendix 4**
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	**3.7**
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment, or activities;	**6**
(k) any mitigation measures for inclusion in the EMPr;	**7 & 11**
(l) any conditions for inclusion in the environmental authorisation;	**11**
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	**n/a**
(n) a reasoned opinion— i. as to whether the proposed activity, activities or portions thereof should be authorised; iA. Regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan;	**10 & 11**
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**n/a (see BAR)**
(p) any other information requested by the competent authority	**n/a**
Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	

Contents

1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by Arcus Consultancy Services (Pty) Ltd to compile a heritage impact assessment for the proposed Highlands Wind Energy Facility (WEF) close to Somerset East in Eastern Cape. The project will be split into three phases and will require three grid connections. In total six Environmental Authorisations are being sought. The broader site straddles the R63 road between Pearston and Somerset East and is centred on S33 44' 20" E25 20' 50" (Figure 1). The various proposals have overlapping areas of interest and a single feasibility study was conducted for the whole area in order to assist the developer with designing the WEF layouts which are now being considered at the impact assessment level. The site lies within a Renewable Energy Development Zone (REDZ) and all projects will follow Basic Assessment processes.

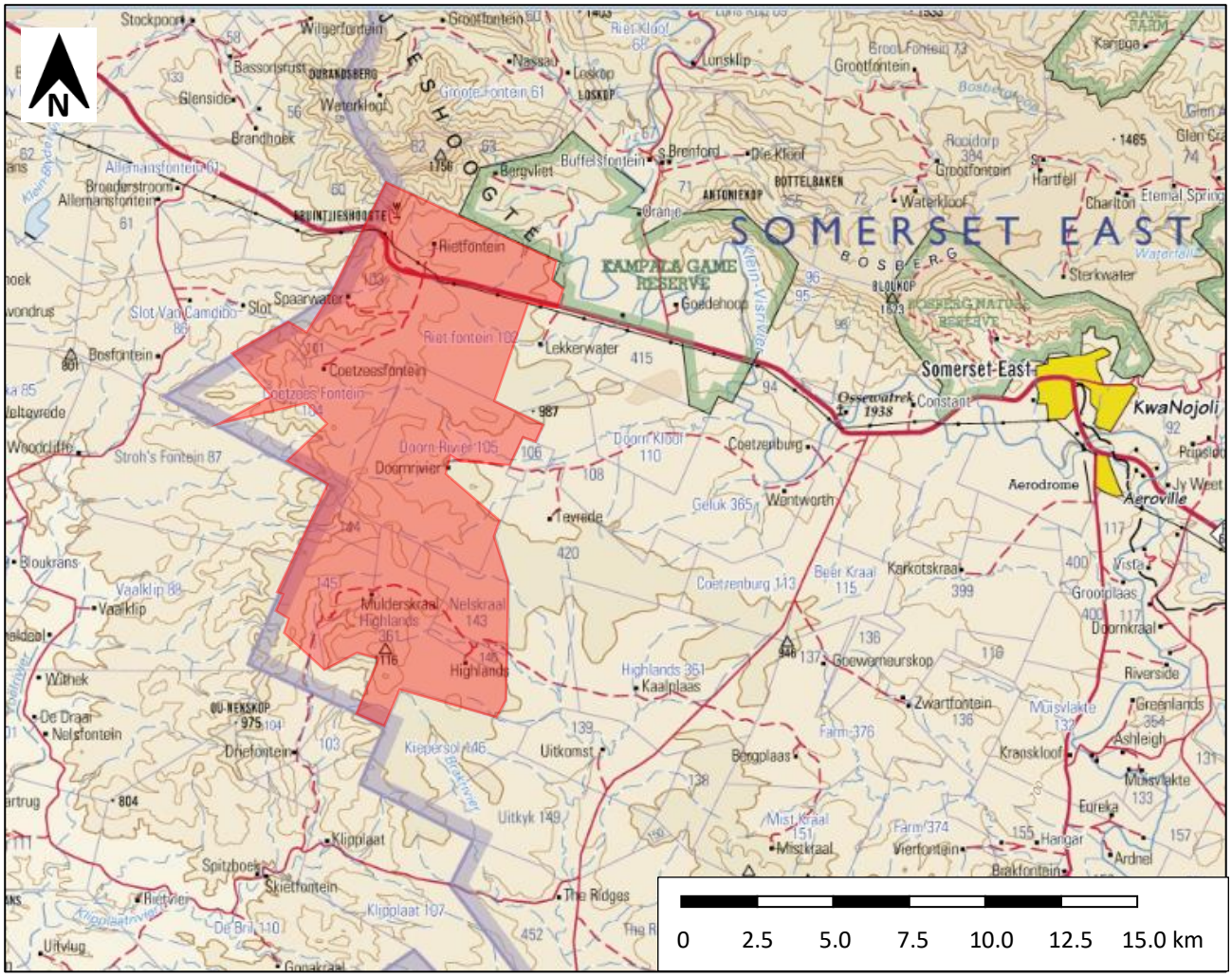

Figure 1: *Extract from 1:250 000 topographic map 3224 showing the location of the study area (red shaded polygon). Source: Chief Directorate: National Geo-Spatial Information. Website: wwwi.ngi.gov.za.*

1.1. Project description

WKN Windcurrent South Africa (Ltd) Pty (WKN-WC) are proposing the Highlands WEF, and associated infrastructure including grid connection infrastructure (the Proposed Development),

located near the town of Somerset East in the Eastern Cape Province. The Proposed Development Site is situated within the Cookhouse REDZ and the affected land parcels cover an area of approximately 11 180 hectares. Table 1 lists the farm portions included within the study area. The area of interest for development within these land parcels is approximately 9000 hectares.

Table 1: *List of farm portions included within the study areas for the various projects.*

Farm portion	Extent	Highlands WEF			Grid connections		
		Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
SAHRIS Case number							
Lekker water 101/2	53.9615 ha	**X**					
Rietfontein 102/0	2443.5062 ha	**X**			**X**	**X**	**X**
Spaarwater 103	854,3907 ha	**X**				**X**	**X**
Coetzees Fontein 104/0	25.5475 ha	**X**					
Coetzees Fontein 104/1	389.4165 ha		**X**			**X**	**X**
Coetzees Fontein 104/2	618,4318 ha		**X**				
Coetzees Fontein 104/5	650.3704 ha	**X**					
Doorn Rivier 105/0	1284.7980 ha		**X**	**X**			**X**
Doorn Rivier 105/1	1027.8384 ha		**X**			**X**	**X**
Nels Kraal 143/0	689.1299 ha			**X**			**X**
Kiepersol 146/1	125,9102 ha			**X**			
Nelskom 144	223.9168 ha						
De Mullers Kraal 145/0	865.3251 ha						
De Mullers Kraal 145/8	0.8765 ha						
Highlands 361/0	1828.8199 ha			**X**			**X**

There are two existing Eskom Transmission lines located within the Proposed Development Site boundary, one a 66 kV and the other a 132 kV. Both have limited available capacity, and both will be required to connect the Highlands WEF to the national grid. In order to comply with the Department of Energy's Renewable Energy Independent Power Producers Programme (REIPPP), a Project can only submit a bid with one grid connection (in this case either the 66kV or 132kV Transmission lines). Therefore, should the Highlands project be bid in the REIPPP, it will be split into two bid submissions, each requiring its own Environmental Authorisation. Based on uncertainty surrounding the available capacities on each line and the downstream constraints (for example the Eskom main transmission system (MTS) substations), it is unknown at this stage how many turbines can connect to each line. The technical and financial feasibility for the optimum Project split can only be determined on finalising the ongoing analysis of meteorological data – this will ultimately determine whether the larger of the two projects connecting to the 132 kV line will be located to the north or the south of the smaller project connecting to the 66 kV line.

Therefore, for the purpose of obtaining Environmental Authorisation, the project has been split into three phases: North, Central and South. If the projects are successful in obtaining Environmental Authorisation the Highlands Central WEF (Phase 2) will be combined with either Highlands North (Phase 1) or Highlands South (Phase 3), depending on meteorological data, for bidding in the REIPPP.

There are six components to the Proposed Development, representing three development phases:

- Highlands North WEF: Phase 1;
- Electrical Grid Connection and Associated Infrastructure for Highlands North WEF Phase 1;
- Highlands Central WEF: Phase 2;

- Electrical Grid Connection and Associated Infrastructure for Highlands Central WEF Phase 2;
- Highlands South WEF: Phase 3; and
- Electrical Grid Connection and Associated Infrastructure for Highlands South WEF Phase 3.

The location of the six components within the Proposed Development Site are presented in Figure 2. It should be noted that this site boundary includes the total area within which all components of the Proposed Development may be developed. The footprint of the combined six development components will only occupy a small portion (approximately 2%) of the land within this boundary, and fall entirely within the REDZ.

The three WEF development phases will comprise of the following:

Highlands North WEF: Phase 1

- The proposed Highlands North WEF will comprise of 17 turbines with a maximum generation capacity of 5 MW per turbine. Internal roads will connect the turbines. On-site cabling will largely follow the road infrastructure where possible, and will be either overhead, or underground. One on-site substation location (Substation A) will form part of this application.

Highlands Central WEF: Phase 2

- The proposed Highlands Central WEF will comprise of 14 wind turbines, with each turbine having an installed maximum generation capacity of 5 MW per turbine. Internal roads will connect the turbines. On-site cabling will largely follow the road infrastructure where possible, and will be either overhead, or underground. One on-site substation location (Substation B) will form part of this application. An existing access road may require upgrading as part of this application.

Highlands South WEF: Phase 3

- The proposed Highlands South WEF will comprise of 18 wind turbines, with each turbine having an installed maximum generation capacity of 5 MW per turbine. Internal roads will connect the turbines. On-site cabling will largely follow the road infrastructure where possible, and will be either overhead, or underground. Two on-site substation locations (Substation C1 and C2) will form part of this application. An existing access road may require upgrading as part of this application.

It is important to note that while Environmental Authorisation will be sought for four substation locations, only a maximum of two substation locations will be used for the actual construction, to connect the two windfarms to the two Eskom transmission line tie-ins.

For all three phases turbines with a maximum height to blade tip of 200 m will be considered (a hub height of up to 135 m, and a rotor diameter of up to 150 m).

In addition to the Highlands WEF, WKN-WC also proposes obtaining Environmental Authorisation from the Department of Environmental Affairs (DEA) for Eskom Transmission and Eskom Distribution Grid Connections to connect the WEFs to the national grid. If Environmental Authorisation is granted, and the project receives preferred bidder status this will be entirely or partially transferred from the Project(s) to Eskom Holdings SOC Limited (Eskom) as applicable in advance of construction. The grid connection infrastructure will be routed from a start location within the WEF Site Boundary to the existing National Grid, which is also within the WEF site boundary (Figure 2).

The three grid connections and associated infrastructure will comprise of the following:

Electrical Grid Connection and Associated Infrastructure for Highlands North WEF Phase 1:

- The proposed Grid Connection will connect Substation A to the Eskom transmission line. Two route alternatives are proposed. The maximum length will be 5 km with a 31 m wide servitude. A 300 m corridor surrounding the proposed line alternatives is to be assessed (150 m each side). The line will either be a 66 kV line, or a 132 kV line.

Electrical Grid Connection and Associated Infrastructure for Highlands Central WEF Phase 2:

- The proposed Grid Connection will be a 132 kV line. It will connect Substation B to the Eskom transmission line. Two route alternatives are proposed. The maximum length will be 8 km with a 31 m wide servitude. A 300 m corridor surrounding the proposed line alternatives is to be assessed (150 m each side).

Electrical Grid Connection and Associated Infrastructure for Highlands South WEF Phase 3:

- The proposed Grid Connection will connect Substation C1 and C2 to the Eskom transmission line. Two route alternatives are proposed. It will be either a 66 kV line or a 132 kV line or both. The maximum length of the line will be 20 km with a 31 m wide servitude. A 300 m corridor surrounding the proposed line alternatives is to be assessed (150 m each side).

For all three grid connections the pylons would be up to30 m high. Both monopole and lattice towers are being considered.

1.1.1. Alternatives

Note that no alternatives for the wind energy facilities are being assessed because the preferred layout has been designed so as to avoid environmental sensitivities identified during the feasibility studies. There are two alternative alignments for each grid connection.

1.1.2. Aspects of the project relevant to the heritage study

All aspects of the proposed development are relevant since excavations for foundations and/or services may impact on archaeological and/or palaeontological remains, while all above-ground aspects create potential visual (contextual) impacts to the cultural landscape and any significant heritage sites that might be visually sensitive.

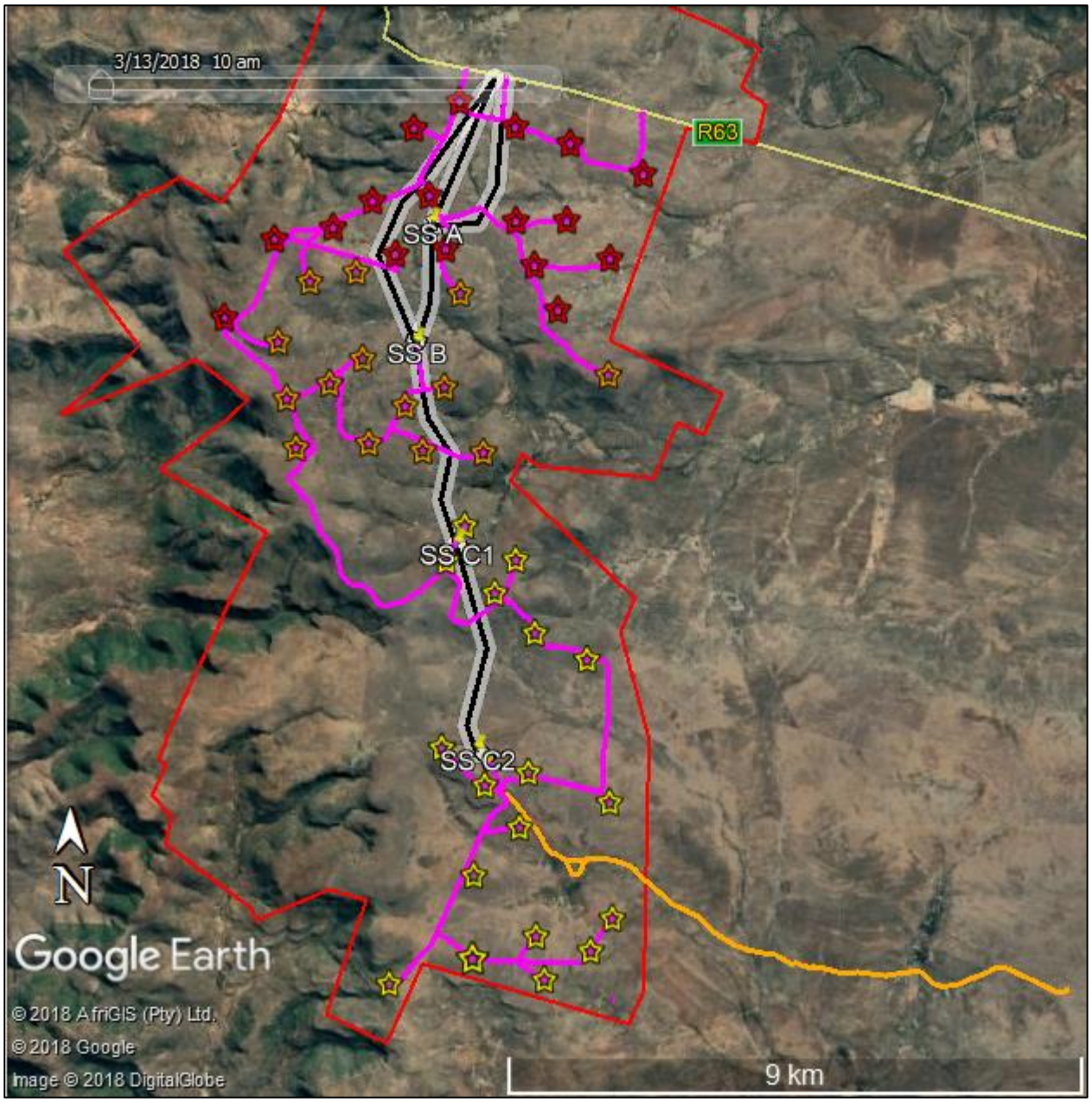

Figure 2: *Aerial view of the study area (red polygon) showing the proposed facility layouts. Red, orange and yellow stars represent the turbines of Phases 1, 2 and 3 respectively, while the pink lines show the facility access roads. The white/black lines show the grid connection corridors and centre lines and the four substation locations are marked (SS A, SS B, SS C1 & SS C2). The orange line represents an access road that may require upgrading to facilitate access to the study area. Note that internal cabling largely follows the roads and has not been included on this map so as to make for easier reading.*

1.2. Terms of reference

ASHA Consulting was requested to:

- Prepare a screening study to inform the development of site layouts and provide sensitivity mapping;
- Conduct a site visit to locate sensitive heritage resources in the study area;

- Prepare a Heritage Impact Assessment (HIA) that assessed the six proposed projects. The assessment was to be done as a single report but with separate impact assessment sections for the six proposed developments; and
- Subcontract a palaeontological specialist to provide a fieldwork-based palaeontological specialist study for inclusion on the HIA.

1.3. Scope and purpose of the report

An HIA is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued by them for consideration by DEA who will review the Basic Assessment Report (BAR) and grant or refuse authorisation. The HIA report will outline any management and/or mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the conditions of authorisation should this be granted.

1.4. The author

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting Heritage Impact Assessments and archaeological specialist studies in South Africa (primarily in the Western Cape and Northern Cape provinces) since 2004 (please see curriculum vitae included as Appendix 1). He has also conducted research on aspects of the Later Stone Age in these provinces and published widely on the topic. He is an accredited heritage practitioner with the Association of Professional Heritage Practitioners (APHP; Member #43) and also holds archaeological accreditation with the Association of Southern African Professional Archaeologists (ASAPA) CRM section (Member #233) as follows:

- Principal Investigator: Stone Age, Shell Middens & Grave Relocation; and
- Field Director: Colonial Period & Rock Art.

1.5. Declaration of independence

ASHA Consulting (Pty) Ltd and its consultants have no financial or other interest in the proposed development and will derive no benefits other than fair remuneration for consulting services provided. Please see full declaration contained in Appendix 2.

2. HERITAGE LEGISLATION

The National Heritage Resources Act (NHRA) No. 25 of 1999 protects a variety of heritage resources as follows:

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old;
- Section 36: graves and human remains older than 60 years and located outside of a formal cemetery administered by a local authority; and
- Section 37: public monuments and memorials.

Following Section 2, the definitions applicable to the above protections are as follows:

- Structures: “any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith”;
- Palaeontological material: “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 or trace”;
- Archaeological material: a) “material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures”; b) “rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation”; c) “wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation”; and d) “features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found”;
- Grave: “means a place of interment and includes the contents, headstone or other marker of such a place and any other structure on or associated with such place”; and
- Public monuments and memorials: “all monuments and memorials a) “erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government”; or b) “which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual.”

While landscapes with cultural significance do not have a dedicated Section in the NHRA, they are protected under the definition of the National Estate (Section 3). Section 3(2)(c) and (d) list “historical settlements and townscapes” and “landscapes and natural features of cultural significance” as part of the National Estate. Furthermore, Section 3(3) describes the reasons a place or object may have cultural heritage value; some of these speak directly to cultural landscapes.

Section 38(8) of the NHRA states that if an impact assessment is required under any legislation other than the NHRA then it must include a heritage component that satisfies the requirements of S.38(3). Furthermore, the comments of the relevant heritage authority must be sought and considered by the consenting authority prior to the issuing of a decision. Under the National Environmental Management Act (No. 107 of 1998; NEMA), as amended, the project is subject to a BAR. The present report provides the heritage component. Eastern Cape Provincial Heritage Resources Authority (ECPHRA) required to provide comment on the proposed project in order to facilitate final decision making by the DEA.

3. METHODS

3.1. Literature survey and information sources

A survey of available literature was carried out to assess the general heritage context into which the development would be set. This literature included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS). The 1:50 000 map and historical aerial images were sourced from the Chief Directorate: National Geo-Spatial Information.

3.2. Field survey

The larger site was subjected to a combined vehicle and foot survey by two archaeologists (Dr Jayson Orton and Madelon Tusenius) on 7th to 10th February 2018. This was in late summer, although in this relatively dry area there is not much seasonal variation in vegetation cover that might affect the survey quality. During the survey the positions of finds and survey tracks were recorded on hand-held Global Positioning System (GPS) receivers set to the WGS84 datum. Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

3.3. Specialist studies

One specialist study was commissioned for this HIA. This was a palaeontological study carried out by Dr John Almond of Natura Viva cc. This study is incorporated within the present HIA and included in full as Appendix 3.

3.4. Impact assessment

For consistency among specialist studies, the impact assessment was conducted through application of a scale supplied by ARCUS Consultancy Services. This is based on the Hacking methodology.

3.5. Grading

S.7(1) of the NHRA provides for the grading of heritage resources into those of National (Grade I), Provincial (Grade II) and Local (Grade III) significance. Grading is intended to allow for the identification of the appropriate level of management for any given heritage resource. Grade I and II resources are intended to be managed by the national and provincial heritage resources authorities respectively, while Grade III resources would be managed by the relevant local planning authority. These bodies are responsible for grading, but anyone may make recommendations for grading.

It is intended under S.7(2) that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. SAHRA (2007) has formulated its own system[1] for use in provinces where it has commenting authority. In this system sites of high local significance are given Grade IIIA (with the implication that the site should be preserved in its entirety) and Grade IIIB (with the implication that part of the site could be mitigated and part preserved as appropriate) while sites of lesser significance are referred to as

[1] The system is intended for use on archaeological and palaeontological sites only.

having ‘General Protection’ and rated with an A (high/medium significance, requires mitigation), B (medium significance, requires recording) or C (low significance, requires no further action).

3.6. Consultation

The NHRA requires consultation as part of an HIA but, since the present study falls within the context of a BAR which includes a public participation process (PPP), no dedicated consultation was undertaken as part of the HIA. Interested and affected parties would have the opportunity to provide comment on the heritage aspects of the project during the PPP.

3.7. Assumptions and limitations

The field study was carried out at the surface only and hence any completely buried archaeological sites and/or palaeontological occurrences would not be readily located. Similarly, it is not always possible to determine the depth of such material visible at the surface. The site was very large and a preliminary layout was only supplied during the site visit. We did, however, have access to a map of the ‘buildable areas’ as compiled after specialist screening inputs and we attempted to visit as many of these areas as possible. Figure 3 shows the survey coverage. It is assumed that the general distribution of heritage resources – with the vast majority occurring in valleys – will hold true throughout the study area.

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The broader site lies on a chain of north-south trending ‘foothills’ at the base of Bruintjieshoogte, a mountain forming part of the Great Escarpment. It is crossed in the far north by the R63 which links the towns of Pearston in the west and Somerset East in the east. Two powerlines also traverse the northern end of the site with the southern one effectively forming the northern boundary of the buildable area. The land is used largely for grazing and existing infrastructure is generally limited to farm complexes, fences and farm tracks.

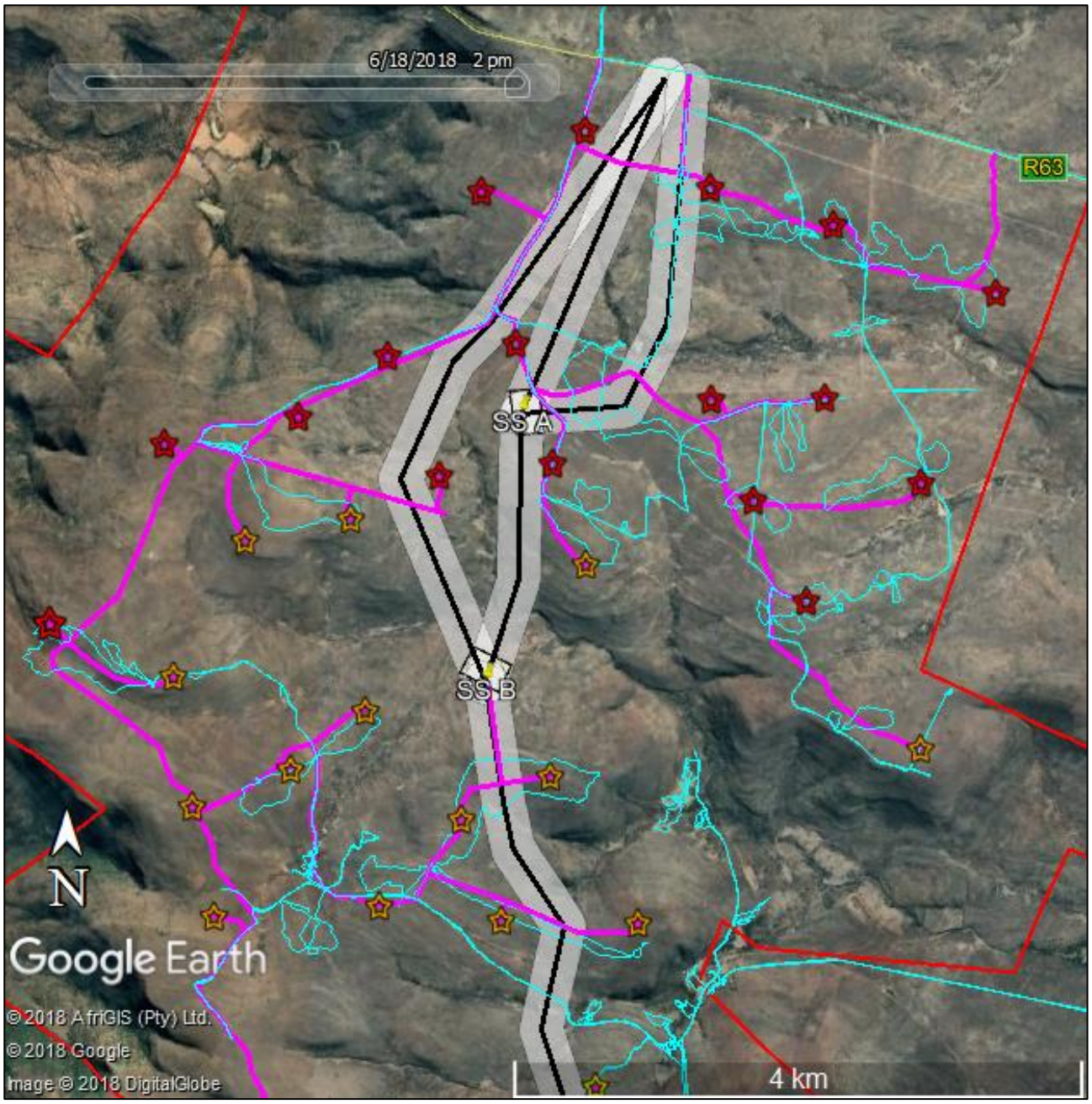

Figure 3: *Aerial view of the northern part of the broader study area (red polygon) showing the proposed development (see Figure 2 caption) and the survey tracks (turquoise lines.*

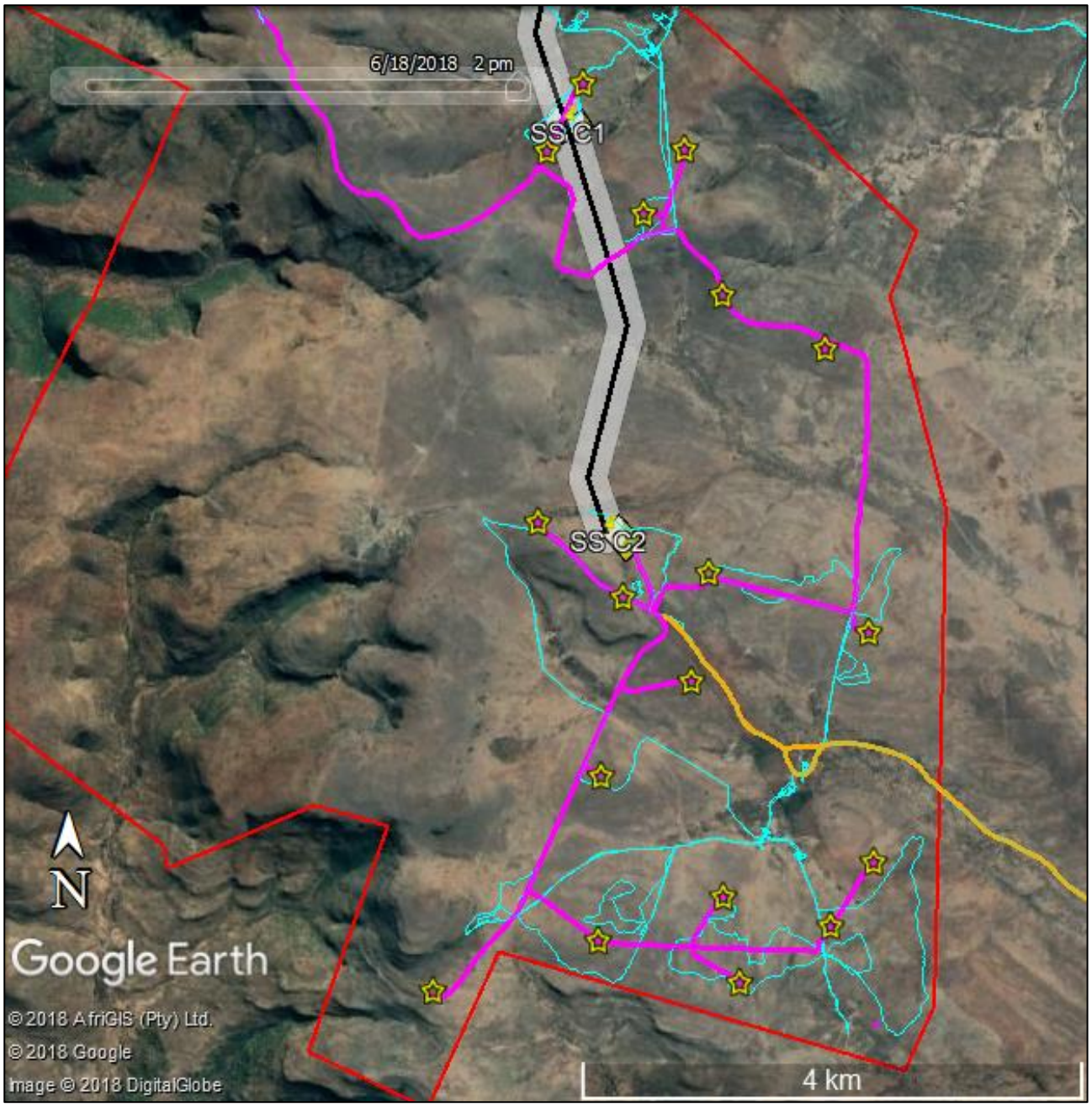

Figure 4: *Aerial view of the southern part of the broader study area (red polygon) showing the proposed development (see Figure 2 caption) and the survey tracks (turquoise lines.*

4.2. Site description

The study area is comprised of rolling hills and valleys that generally lack any steep topography or vertical rock outcrops (Figures 5 to 10), although surface rock exposures are locally abundant in places. Only one hill was found to be quite rocky with sandstone rocks tumbling down its side (Figure 10). Although one large hill in the north-eastern part of the Highlands Central Phase 2 study area was almost entirely composed of weathered dolerite at the surface, only one area of outcropping dolerite boulders was seen just above the escarpment in the west of the study area (Figure 11). Another hillside in the western part of the Highlands Central Phase 2 study area was found to have many small dolerite rocks over its surface Figure 12). Areas of flat sandstone were noted in many places (Figures 13 & 14).

Vegetation cover tended to be low with grass present throughout. This varied in density but was generally sparse enough to reveal the substrate quite clearly. Occasionally in areas of deeper soil the grass cover was far denser (Figure 16). Larger vegetation on the open hills was limited to occasional patches of thorn trees and other bushes (Figures 11, 12 & 15) as well as old groves of prickly pear (Figure 12). The ground surface was largely intact but some areas of fairly active erosion were noted in valleys (Figure 17).

Figure 5: *View towards the southeast across the southern part of Farm 102/rem. This is the southern part of the Highlands North Phase 1 project area.*

Figure 6: *View towards the southwest across the small west-east trending valley that lies in the south-eastern part of Farm 102/rem. This is in the centre east of the Highlands North Phase 1 study area.*

Figure 7: *View towards the southwest from the south-eastern part of Farm 102/rem. The Highlands Central Phase 2 study area lies on the distant hills.*

Figure 8: *View towards the southwest into the valley that lies in northern part of Farm 105/rem and in between the Highlands Central Phase 2 and Highlands South Phase 3 study areas.*

Figure 9: *View towards the northeast from Farm 104/2 showing the Bruintieshoogte Mountains just left of centre. Somerset East is located at the foot of the mountains in the far distance. This photograph is from the south-western part of the Highlands Central Phase 2.*

Figure 10: *View towards the northeast from a hill in the south of Farm 361/0 and in the south-western corner of the Highlands South Phase 3 study area. This hill was more rocky than most.*

Figure 11: *View towards the north of a dolerite outcrop on Farm 104/5 in the south-western corner of the Highlands North Phase 1 study area.*

Figure 12: *View of a dense patch of vegetation that has both prickly pears and torn trees in it on Farm 104/2 in the north-eastern part of the Highlands Central Phase 2 study area.*

Figure 13: *View towards the north from the southern part of Farm 361/0 and the southern part of the Highlands South Phase 3 study area. The pale area to the right is exposed bedrock.*

Figure 14: *View of an area of exposed and weathering bedrock in the central part of farm 102/rem. This is in the north of the Highlands North Phase 1 study area.*

Figure 15: *View of a cluster of thorn trees in the central part of farm 102/rem. This is in the north of the Highlands North Phase 1 study area.*

Figure 16: *Example of dense grass cover on Farm 104/1 in the northwest part of the Highlands Central Phase 2 study area.*

Figure 17: *View towards the south of a heavily eroding area in the large valley on Farm 105/1 and in the western part of the Highlands Central Phase 2 study area.*

5. HERITAGE CONTEXT

This section of the report contains the desktop study and establishes what is already known about the archaeological heritage in the vicinity of the study area. This will assist in the interpretation and understanding of the newly reported material.

5.1. Palaeontological aspects

The entire study area is deemed to be highly sensitive according to the SAHRIS Palaeontological Sensitivity Map (Figure 18). Only alluvial sediments and dolerite outcrops (shaded green and grey respectively on Figure 18) are of lesser sensitivity. For this reason Dr John Almond was contracted

to compile a specialist palaeontological report which can be consulted in Appendix 2 of the present report.

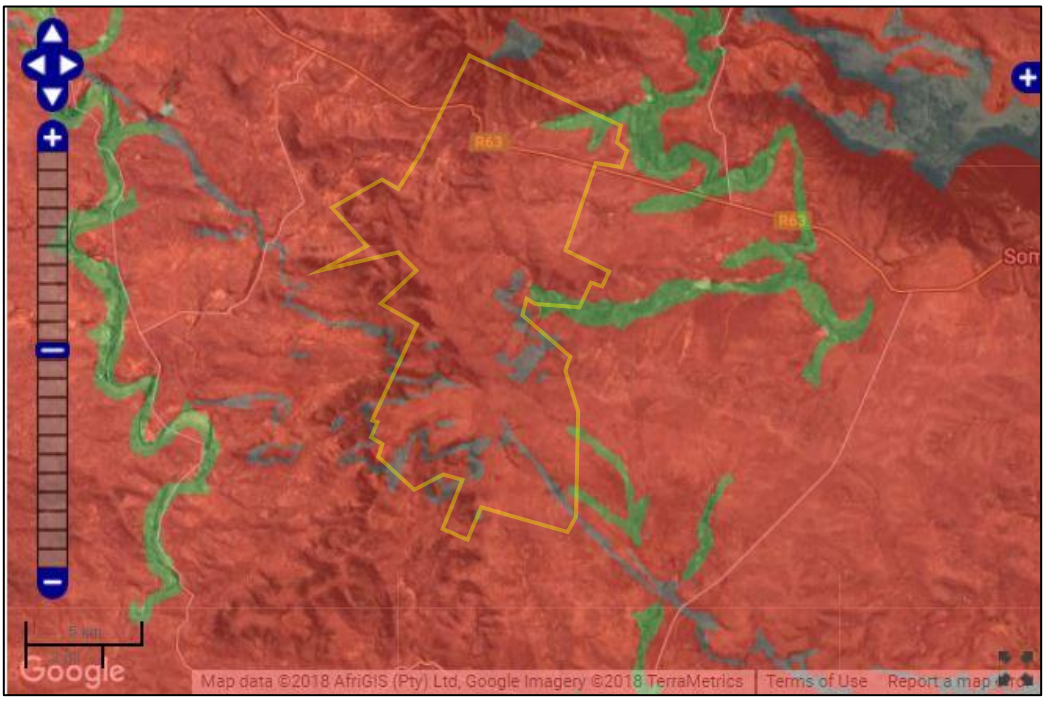

Figure 18: *Extract from the SAHRIS Palaeontological sensitivity map showing the study area (yellow polygon) to be of very high palaeontological sensitivity (red shading). The green areas are of moderate sensitivity and the grey areas zero sensitivity.*

5.2. Archaeological aspects

Very little is known of the archaeology of this part of Eastern Cape as little systematic work has been done. The Albany Museum in Grahamstown holds stone artefacts from the Cradock area that were donated by members of the public from as early as the 1880s (Binneman 2012a; Booth 2011). Some of these collections derive from freshwater mussel middens containing stone artefacts and pottery from the banks of the Great Fish River.

The majority of observations from this region come from the Cookhouse/Bedford area – some 45km east of Somerset East. There, surveys have documented numerous occurrences of Early (ESA), Middle (MSA) and Late Stone Age (LSA) archaeological material and a range of more recent heritage resources such as farm houses (sometimes fortified), ruins, sheds, stone kraals, historic refuse middens, farm cemeteries, unmarked graves and stone cairns.

ESA artefacts occur in varying concentration throughout the Cookhouse/Bedford area. The actual identification of discrete archaeological sites is difficult as the presence or absence of artefacts appears to be a function of erosion and deposition rather than discreet anthropogenic events (Halkett et al. 2010). This means they are better described as being part of the local background scatter (see Orton 2016). Where erosion occurs, artefacts are often visible and their frequency tends to increase in proximity to the larger rivers in the area – the Great and Little Fish Rivers (Hart & Webley 2011). Alluvial gravels sometimes contain artefacts indicating that early humans had been active there, selecting river cobbles as material for making stone tools (Halkett & Webley 2009).

Formal artefacts were largely absent from these quarry assemblages. No ESA sites with fossil bone or other organic material were identified during these surveys (Halkett & Webley 2009; Halkett et al. 2010; Booth 2011). Binneman (2012a) observed that ESA implements have been recorded from excavations at the Cradock springs in that town.

Middle Stone Age material was found scattered throughout the Cookhouse/Bedford area and may be described as the dominant Stone Age archaeological material (Halkett & Webley 2009; Booth 2011). Once more, definable archaeological sites could not be easily identified due to the universal spread of artefacts resulting from both erosion and overprinting over many thousands of years (Binneman 2012a). The material may be described as background scatter. The scatters contain both flakes and blades and relatively dense scatters were identified and recorded in places. A survey by Hart & Webley (2010) on farms along the R61 to the west of Cradock, identified surface scatters of MSA and LSA artefacts and a "factory" or "quarry" site. Binneman (2012a, b) noted that MSA artefacts are found throughout the area but since they are generally located in the open and are of mixed age, it is difficult to assign them to a particular industrial complex. MSA occupation was found at Highlands Rock Shelter, some 100 km north of the study area (Deacon 1976).

Late Stone Age sites are attributed to the ancestors of the San people and pastoralists groups (the latter after 2000 years ago). The legacy of the San includes numerous open sites, while traces of their presence can also be found in most rock shelters, often including rock art. They frequently settled near permanent water sources (springs or waterholes) and made use of natural shelters such as rock outcrops or large boulders.

The introduction of pastoralism (sheep and goats, later cattle) roughly 2000 years ago was a significant event in the prehistory of southern Africa. According to the historic records the Khoekhoen pastoralists were divided into large tribal communities, distributed along the coastal plains and as far northeast as Graaff Reinet. These transhumant communities (herding cattle and sheep) may have utilized the grazing opportunities of the Karoo on a seasonal basis but information on this is limited. The San appear to have retreated to the Great Karoo with the arrival of the first Dutch trekboers in the mid-18th century.

LSA material is less common in the Cookhouse/Bedford area, but closer to rivers sites can be found. Halkett *et al.* (2010) found a number of LSA sites along water courses. Pottery sites seemed to be quite common with some even including some possibly Iron Age pottery. Hart & Webley (2011) recorded only two sites, both containing indigenous pottery indicating an age of less than 2000 years, while to the east of Cookhouse Booth (2011) reported a single LSA artefact scatter comprising of a variety of flakes, cores and formal tools on various local and non-local raw materials. Binneman (2012a) also reports scatters of LSA artefacts from the Bruintjies Hoogte Mountains to the east of Pearston and one scatter from an area just southwest of Pearston (Binneman 2012b).

Excavations by Hewitt (1931) at Tafelberg Hall (some 120 km north of the present study area) and by Deacon (1976) at Highlands Rock Shelter (some 100 km north of the present study area) have produced LSA occupation deposits. Deacon also refers to work on a freshwater mussel shell midden on the Fish River but this unfortunately was never published.

The only other systematic survey and recording in the vicinity of the project area was conducted in the Mountain Zebra National Park (some 50km to the north near Cradock) by Brooker (1974). She recorded a different pattern to that in the Cookehouse/Bedford area; she found LSA sites to be most

common with little evidence for the ESA or MSA in the Park. She documented 30 archaeological sites including three small rock shelters and 27 open sites along river valleys.

The survey of the Mountain Zebra National Park confirmed the presence of rock art in the area. One of the painted shelters contained images of antelope, human figures, a feline and some baboons (Brooker 1974). Binneman (2012a, b) reported that there are a few records of faded rock paintings in the Bruintjies Hoogte Mountains.

Formal farm graveyards occur in the vicinity of most farmhouses in the region. These cemeteries are often fenced and easily recognisable. More difficult to identify are the graves of farm workers, which are frequently overgrown and not fenced. Various surveys have also recorded stone cairns and enigmatic small stone circles (0.5 m diameter) which could represent graves of Khoekhoen herders from the late prehistoric period (Hart & Webley 2010, 2011).

5.3. Historical aspects

Immediately beyond the Sneeuberg (section of the Great Escarpment in the Murraysberg to Craddock area) lies a spur of high country running in a south-easterly direction away from the escarpment toward the Fish River. This high country was known as Bruintjies Hoogte[2]. It was superb cattle country. At the beginning of the 1770's the trekboers began moving into the country between Bruintjes Hoogte and Algoa Bay, known as the Zuurveld. The Dutch East India Company decided to proclaim a formal boundary beyond which the colonists could not go. This stretched from Bruintjes Hoogte in the north to Algoa Bay on the coast.

Colonial trekboer settlement of the area immediately east of Bruintjies Hoogte commenced in the 1770s. The trekboer and hunter Willem Prinsloo decided to ignore the new border proclamation and he set himself up on two farms beyond Bruintjies Hoogte in the Fish River Valley. Other colonists joined him and very soon the Company conceded that the trekboers could keep their farms in the area beyond Bruintjes Hoogte, also known as Agter Bruintjies Hoogte. The latter term refers to the area between the Bruintjieshoogte Mountains and the present town of Somerset East, an area traversed by the route from the Cape (Skead 2007: 110). Botha (1926: 70) says that a farm was issued "aan de Kamdeboosberge aan de Bruynshoogte" in 1770 and this may have been the first official trekboer settlement of the area. Survey diagrams, however, indicate the first formal land grants in the study area as having occurred in 1818 under quitrent[3].

At this time, many farmers in the Sneeuberg abandoned their farms because of Bushmen attacks and followed Prinsloo eastward. However, this resulted in trekboer and Xhosa groups moving steadily closer together. Skead (2007) is of the opinion that at this time the Xhosa had not settled in strength, but infiltrated the area as wandering hunters as an advance guard of future permanent residence by a population moving westward. At this time, the Gqunukhwebe (a mixed Khoekhoen-Xhosa chiefdom) were living in the Zuurveld (area around Grahamstown). A new boundary was proclaimed along the Fish River in 1778. By 1780, fighting had broken out between the trekboers and the Xhosa beyond Bruintjes Hoogte. Prinsloo had his farm burned. In 1781, van Jaarsveld

[2] Various historical spellings occur and include De Bruynshoogte, De Bruyn's Hoogte, Bruintjes Hoogte and Bruintjeshoogte but Bruintjies Hoogte appears on the modern map and is used in this report.
[3] A quitrent was a form of tax that freed the holder of a piece of land from having to perform certain duties to a higher authority, in this case the colonial government.

established a base in Prinsloo's farmhouse and attacked the Xhosa living in the area, precipitating the first of nine frontier wars. There is some uncertainty about the exact location of Prinsloo's farmstead, but there is a claim that it was at the foot of the Boschberg, where Somerset East is located today (Schoeman 2013; Skead 2007).

By 1814, Prinsloo's farm had been purchased jointly by Trichardt (one of the early leaders of the Great Trek) and Bester. Lord Charles Somerset initiated a plan for an experimental farm in the area and the American botanist Dr Mackrill choose this farm (named Boschberg). The farm was established in 1815, for the purpose of improving stockbreeding in the Cape Colony and providing produce for the soldiers on the frontier. It was named 'Somerset Farm'. In 1825 Somerset established a drostdy on the farm site, and it was proclaimed as 'New Drostdy in Bruintjies Hoogte'. The town which grew up under the Boschberg was known as Somerset until about 1857, when 'East' was added to the name (Schoeman 2013; Blue Crane Route Tourism 2017).

The Bruintjies Hoogte ridge, on the R63 midway between Pearston and Somerset East, was crossed by Swellengrebel in 1776 and Gordon in 1777 (Ross 2013). It was initially named De Bruynshoogte by the boundary commission led by Faber & Mentz in 1769-1770. According to Ross (2013), the Central Road Board (CRB) was responsible for the construction of the Bruintjies Hoogte Pass, he does not provide a date but the CRB was active in the mid-19th century. The pass was tarred during 1964/65.

There was also a government outspan called "Bruintjeshoogte", between Somerset East and Pearston by 1857 (Figure 19). Various memorials for the lease of this outspan exist (Cape Archives). The toll at this outspan was only abolished in 1889 (KAB PWD 2/5/396). The Surveyor General diagram for Spaarwater 103 (No A973 of 1923), shows the location of the outspan, immediately west of the Bruintjes Hoogte Pass. It suggests that travellers along this road from the Cape, stopped off before ascending the pass. The outspan must have been on land now forming part of Farm Bruintjieshoogte Berg 60, but the survey diagram for that farm (dated 1960) does not provide any further information regarding the outspan and the earlier diagrams.

The Bruintjies Hoogte Mountains are an important historic landmark of high significance as they represented the boundary between trekboers and the Xhosa toward the end of the 19th century. Although it is a natural feature, its importance in the regional history is high. The Bruintjies Hoogte Pass is also significant as an important route from the Cape Colony into the Eastern Cape.

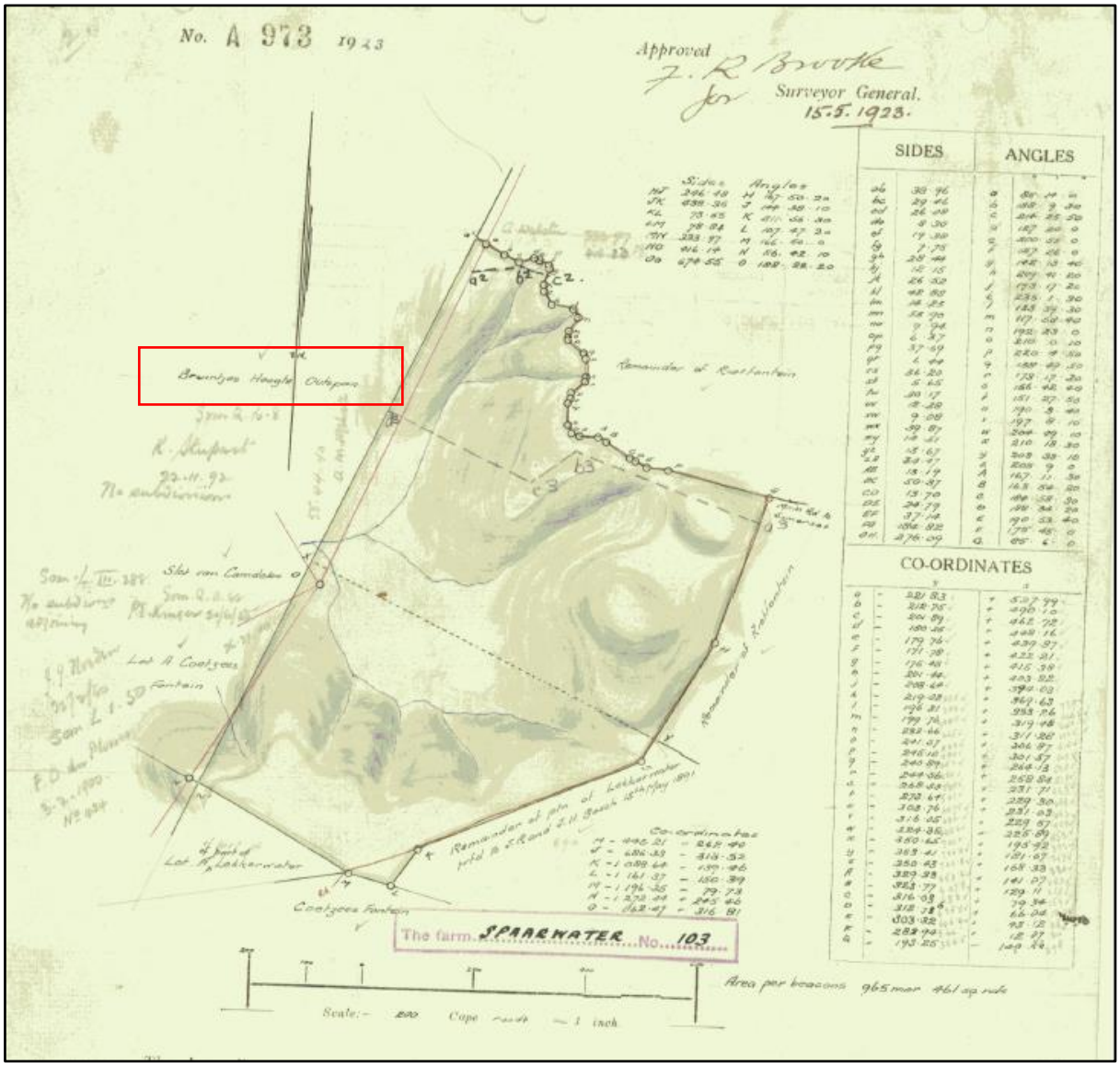

Figure 19: *The farm Spaarwater 103, includes the Bruintjes Hoogte Pass, and also shows the position of the Bruintjes Hoogte Outspan located just outside the study area (red box around label).*

The following list indicates the dates at which the various farms in the study area were first surveyed and granted:

- Lekker Water 101 (SG 469/1816) was surveyed in 1816 and first granted to Jurgens Potgieter in May 1818.
- Rietfontein 102 (SG 2588/1940) represents the consolidation of various portions of other farms, including Lekkerwater (first granted to JJ Potgieter in 1818).
- Spaarwater 103 was surveyed in 1816 and originally granted to JJ Potgieter in May 1818.
- Coetzees Fontein 104 (SG 479/1816) was surveyed in 1816 and first granted to Laurens Erasmus in 1818. Subsequently in 1860, it was surveyed again for Joshua Norden. The new boundaries show a public road bisecting the property, and a house on the land.
- Doorn Rivier 105 (SG 470/1816) was surveyed in 1816 and granted to Laurens Erasmus in May 1818. The map shows the location of "huts" on a small stream.
- Nels Kraal 143 (SG 1250/1856) was granted to Petrus Fourie in 1857.

- Nelskom 144 (SG B/8/1860) was surveyed for Joshua Norden in May 1860.
- De Mullers Kraal 145 (SG 498/1816) was surveyed in 1816 and first granted to Jan Potgieter in May 1818. The map shows some "huts" near a "small spring".
- Kiepersol 146 (SG 491/1816) was surveyed in 1816 and granted to Willem Lotter and Christoffel Son, in 1818.
- Highlands 361 (SG 3015/66) comprises portions of several other farms, consolidated in 1966.

Many of the farms in the area, were surveyed relatively early (1816) and there is a high possibility of significant early farm buildings in the area, as well as farm cemeteries. Halkett *et al.* (2010) recorded many significant heritage buildings in the area south of Bedford.

6. FINDINGS OF THE HERITAGE STUDY

In the sections that follow a selection of heritage sites are illustrated and described in order to allow the reader to gain a visual understanding of the nature of the resources. The full list of finds recorded during the field survey is included in Appendix 3 and they are mapped in Appendix 4.

6.1. Palaeontology

This summary comes from the palaeontological specialist study contained in Appendix 5. The study area is underlain at depth by potentially-fossiliferous fluvial sediments of the Karoo Supergroup (Adelaide Subgroup/Lower Beaufort Group). They are assigned to the Late Permian Middleton and Balfour Formations. Bedrock exposures are very limited due to extensive cover by soils and coarse gravels as well as well-developed, semi-consolidated colluvial / alluvial deposits of the Pleistocene to Holocene Masotcheni Formation along major drainage lines.

The Lower Beaufort Group sediments around Bruintjieshoogte are characterised by sparse fossil vertebrates (especially therapsids) of the Late Permian *Cistecephalus* Biozone, plants and petrified wood of the Gondwanan *Glossopteris* Flora, as well as rare tuffs (volcanic ashes) of importance for radiometric dating. However, the only fossil remains recorded during the fieldwork comprised very rare therapsid skeletal remains (including two skulls and unidentified postcrania) within ferruginous carbonate concretions, several putative large (*c.* 15-30 cm wide) vertebrate burrows, rippled sandstone paleosurfaces associated with reedy plant stem casts and invertebrate burrows, and concentrations of sizeable (2 cm wide) sphenophyte fern stem impressions (horsetails) – all from the Middleton Formation. There was no petrified wood. No fossil material – such as bones and teeth of extinct mammals or reworked petrified wood – was recorded within the Pleistocene/Holocene-aged colluvial/alluvial deposits of the Masotcheni Formation in the major river valleys.

6.2. Archaeology

In general archaeological remains were found to be sparsely scattered across the study area. The vast majority were located along water courses with low density scatters of ESA and MSA artefacts found on the open hills (Figures 20 & 21). These artefacts are of Pleistocene age. The one exception

was a scatter of artefacts that were most likely from the LSA (Figure 22) and that may well have been where they were because of an outcrop of good rock nearby (none was seen though). Although relatively little time was spent surveying in the river valleys (because the development will not be focused in those areas), it was clear that LSA sites dating to the Holocene – and probably mostly the late Holocene – were far more likely to be found in these locations. Figure 23 shows artefacts found in a valley with a small spring in it on Farm 105/rem. Many artefacts were seen there over a fairly wide area bisected by a farm road.

Figure 20: *ESA artefacts from waypoint 1715. Scale bar in 2 cm intervals.*

Figure 21: *ESA artefacts from waypoint 1716. Scale bar in 2 cm intervals.*

Figure 22: *LSA artefacts from waypoint 1761. Scale bar in 2 cm intervals.*

Figure 23: *LSA artefacts from waypoint 1733. Scale bar in 2 cm intervals.*

Historical archaeological materials were also strongly focused on the river valleys because it is there that settlement took place. Occasional artefacts were seen elsewhere but never anything significant. The most important artefact scatter was a low density historical dump associated with an old cottage and located in a farm track (Figure 24). The materials present are typical of 19th century collections from across South Africa. There may be subsurface deposits present there too. Another aspect of historical archaeology is stone quarries. A few were seen and these were used for sourcing stone for building the houses in the area. Figures 25 and 26 illustrate an example.

Figure 24: *Glass and ceramic artefacts from an historical dump at waypoint 1754. One piece of wire and a few bones are also included in the photograph. Scale bar in 2 cm intervals.*

Figure 25: *A small stone quarry at waypoint 1748 used for sourcing building stones.*

Figure 26: *A metal rod that was hammered into a crack in the rock as part of the process of quarrying at waypoint 1748.*

The most important aspect of archaeology is the many historical ruined structures present across the study area. These vary in size and significance. In the far north of the study area, on Farm 102/rem, was a large ruined building and kraal (Figures 25 – 27), while in the centre an extensive complex of historical structures and ruins was evident partly inside and partly outside the study area on Farm 105. Included in this complex are two ruined farm houses that we were told by a farm worker were the first a second farmhouses, each of which was destroyed by fire (Figures 28 & 29). The earlier one likely dates to the mid-19th century and is a vernacular style long house with more recent additions to its eastern end and southern side. The second house is late 19th century in age as suggested by some Victorian features. It too has seen alterations with part of the stoep having ben enclosed. A modern house nearby has subsequently replaced them. Other ruins in this same area include a labourer's cottage that, unusually, was built from bricks and stones together (Figure 30). Another small ruined structure on Farm 361/rem has been reused after falling into ruin (Figure 31). It is on Farm 361/rem.

Figure 25: *Ruin and stone kraal at waypoint 1710. The building has a stone foundation and a combination of sundried bricks (brown) and fired clay bricks (orange) in the walls.*

Figure 26: *The other side of the stone wall visible in Figure 25.*

Figure 27: *Another section of stone walling on the kraal at waypoint 1710.*

Figure 28: *Ruined farm house at waypoint 1729. It likely dates to the mid-19th century but has more recent additions to the east end (left side in this view) and rear.*

Figure 29: *Ruined farm house at waypoint 1722. It likely originates in the late 19th century, possibly in the Victorian period. It has Victorian features but is not typically Victorian in style.*

Figure 30: *Ruined labourer's cottage at waypoint 1731.*

Figure 31: *A small ruined structure at waypoint 1811 that has been reused more recently as an animal enclosure.*

Other stone-built archaeological features included a large historical livestock enclosure with four compartments on Farm 104/2 (Figure 32), a threshing floor (*trapvloer*) on Farm 146/1 (Figure 33) and a small 'pile' of rocks of unknown function on Farm 102/rem (Figure 34).

Figure 32: *Large stone-built livestock encosure at waypoint 1762.*

Figure 33: *A* trapvloer *at waypoint 1800. It was largely buried in the grass and not visible from further away.*

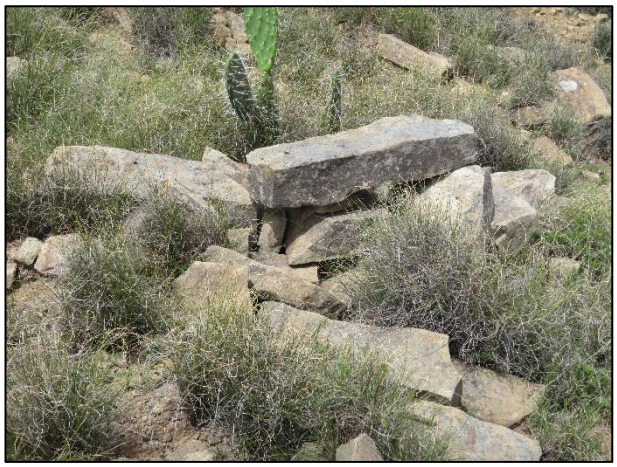

Figure 34: *Small 'pile' of rocks of unknown function at waypoint 1713.*

6.3. Graves

A large LSA site with relatively low density artefact scatter was located along a river valley on farm 105/1. It contained a number of stone mounds that are very likely to be graves. The site may well have been occupied by Khoekhoen herders. Figures 35 and 36 show examples of the grave mounds in this area.

Two graves were found close to one another near an old farm complex on Farm 105/rem (Figures 37 & 38).

Bosch family graveyard on Farm 105/rem (Figure 39). Three dated graves are 1894, 1901 and 1917.

Nel graveyard on Farm 146/1 (Figure 40). The two graves with headstone are dated 1899 and 1929. A third grave lies nearby and is an informal grave made with packed stones.

Figure 35: *Exampleof a stone-packed LSA grave at waypoint 1788.*

Figure 36: *Example of a stone-packed LSA gracve at waypoint 1796.*

Figure 37: *A standing stone that very likely represents the headstone of a grave at waypoint 1752.*

Figure 38: *A standing stone that very likely represents the headstone of a grave at waypoint 1753.*

Figure 39: *Farm graveyard located at waypoint 1778.*

Figure 40: *Farm graveyard at waypoint 1801. It includes two formal graves (background) and a separate small informal stone mound grave (foreground).*

6.4. Built environment

Buildings are largely concentrated in the valleys. The complex on Farm 105 contains many buildings and ruins. Figure 41 shows an example of a farm shed, Figure 42 shows a small labourers' cottage. There are structures of varying age with the older ones tending to be in worse condition.

The farm complex on Farm 146/1 was party ruined but a beautiful 19th century cottage was largely intact and still in use, despite its poor condition Figure 43). Nearby, but on Farm 361/rem, there was a late 19th century farmhouse that has had its entire inside stripped out in order to turn it into a barn/shed (Figure 44).

Figure 41: *A farm shed at waypoint 1725.*

Figure 42: *A labourer's cottage at waypoint 1727.*

Figure 43: 19th century cottage at waypoint 1799.

Figure 44: *A late 19th century farmhouse at waypoint 1807.*

6.5. Cultural landscape

It is evident from aerial photography that the broader area consists of a mosaic of farms incorporating in part relict patches of natural landscape together with later layers of cultivation along the rivers and open grazing lands on flat areas. Stands of prickly pears in places attest to the growing of these fruits on the open hillsides. The cultural landscape qualities of the project area are rural with fences (Figure 45), farm tracks and small dams (Figure 46) being ubiquitous. For obvious reasons, both prehistoric and colonial settlement has focussed mainly on the flood plains of the rivers where most of the formal cultivation has occurred. Away from the rivers the land is used mainly for stock grazing. In some parts, especially towards the escarpment edge in the west, one also notices is a strong wilderness ambiance and sense of isolation. The landscape on site does not have remarkable scenic qualities although when viewed from a distance the mountains and escarpment to the north are of aesthetic value.

Figure 45: *A fence line that has incorporated long stones as fence posts at Waypoint 1720.*

Figure 46: *Example of one of the many small dams that occur in valleys throughout the study area. They are common on the higher slopes close to the wind turbine locations.*

The landscape also has historical value as described in the desktop review above (Section 5.3). It was an important part of the expanding colony during the latter part of the 18th century.

6.6. Scenic routes

Scenic routes are mentioned here because they rely on the aesthetic qualities of the natural and cultural landscapes through which they pass and aesthetic value is one of the criteria for cultural significance. The R63 can be considered to be a scenic route with its main value likely being the views of the escarpment located to its north. The landscape to the south is somewhat more monotonous.

6.7. Summary of heritage indicators

Fossils were located in several places in the northern half of the study area but sensitive locations are not impacted by turbine placements. In general the project area is largely of low palaeontological sensitivity. Precolonial and colonial traces are quite common on the landscape but

are strongly tied to the valleys where water and good soil can be obtained. These areas are away from the proposed developments. There are, however, occasional scatters of ESA and/or MSA artefacts located on the exposed hills which could be impacted by the proposed developments. The majority of these resources are likely to be of very low cultural significance and of no further concern. Graves, buildings and other historical resources are also concentrated in river valleys and should not generally be an issue.

The cultural and natural landscape would be impacted but, given the fact that the proposed projects lie within a REDZ, it is expected that a new 'electrical layer' will be added to the landscape over time.

6.8. Statement of significance and provisional grading

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ''cultural significance'' means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

Although some scientifically important fossils were found (potentially Grade GPA), the majority of palaeontological resources in the footprint areas are deemed to have low cultural significance for their scientific value and would be considered Grade GPC resources.

The vast majority of archaeological resources are of low cultural significance for their scientific and historical value (Grade IIIC) but a few LSA sites are deemed to be of medium to high significance either because of their density or for their association with graves (Grade IIIB and IIIA).

Graves are deemed to have high cultural significance for their social value (Grade IIIA).

The built structures in the study area are generally of medium to low cultural significance for their architectural, historical, social and aesthetic significance.

The broader cultural landscape is deemed to have low to medium cultural significance for its historical and aesthetic values, although there are smaller components of this landscape, in valley settings, that are of medium cultural significance.

7. IDENTIFICATION OF IMPACTS AND MITIGATION MEASURES

7.1. Identification of impacts

Impacts to heritage resources occur largely during the construction phase for both the WEFs and power lines when physical disturbance of the landscape occurs. This can be in the form of clearing the surface of vegetation for laydown areas, roads or other project components or the excavation of foundations for turbines, pylons and other infrastructure. These activities would result in the physical disturbance or destruction of heritage resources with fossils and archaeological sites being most at risk. Graves can also be impacted in this way but are generally rare which means that the chances of impacts occurring or low. The wind turbines and associated roads are far more likely to pose a risk to heritage resources than the grid connections because the latter have very small footprints and the power line service road is generally just left as a jeep track. Very few archaeological resources and no graves are currently known from within the project footprints.

Built heritage resources can be at risk due to vandalism or inappropriate reuse. They can also be impacted when roads that pass very close to them are used by heavy vehicles. In the present layout only one built heritage site is implicated but this is on the section of the existing access road to Highlands South Phase 3 which is proposed for realignment.

The cultural landscape is subjected to contextual impacts related to the presence of large structures (wind turbines) and machinery (cranes, trucks) in the otherwise rural landscape. The creation of new gravel roads across the landscape also serves to alter its character and would remove some of the wilderness character.

7.2. Identification of mitigation measures

Monitoring of large excavations by the Environmental Control Officer (ECO) to look for fossils will be important and, should any be found at any stage in the project, the chance finds procedure outlined in the palaeontological specialist study should be applied. Key in managing the impacts to archaeology will be to commission a 'walk-through' survey prior to the start of construction. This survey would identify any sites of cultural significance that lie within the final authorised footprint and make recommendations for any mitigation that may still be required. This mitigation would involve excavation and/or collection of archaeological materials under a permit issued to the appointed archaeologist.

Graves should be avoided. If absolutely necessary, they can be exhumed but it is very strongly preferred that impacts are avoided completely. A consultation process would need to be carried out and a permit issued to the archaeologist conducting the exhumation work. Unmarked graves discovered by accident during development would require exhumation.

Built heritage sites will not be affected by turbines but may have roads passing close to them. In general, all buildings should be treated as no-go areas during all phases of the project. The proposed southern access road realignment should be implemented because this will keep heavy vehicles away from the historic farm complex located there.

It is not generally possible to mitigate impacts to the cultural landscape in relation to wind turbines because they are too large to be screened. Mitigation would revolve around minimising the overall landscape scarring and would include minimising cut and fill operations, minimising unnecessary surface disturbance, ensuring effective rehabilitation of the development area after construction and again after decommissioning. Further measures would be as described by the visual assessment practitioner.

There is one area that should be investigated for avoidance, although this is not required because archaeological mitigation and careful management can minimise impacts. It is located in the south-western part of the Highlands Central Phase 2 WEF area. The proposed access road – which utilises an existing farm road – passes through a small ruined farm complex with an archaeological deposit and two graves. Although the deposit can easily be sampled and all other features avoided, best practice would be to try avoid this area if technically feasible to do so. Figure 47 shows the area concerned and proposes an alternative road alignment that might be considered by the proponent. This alternative route also follows an existing farm road and is shorter.

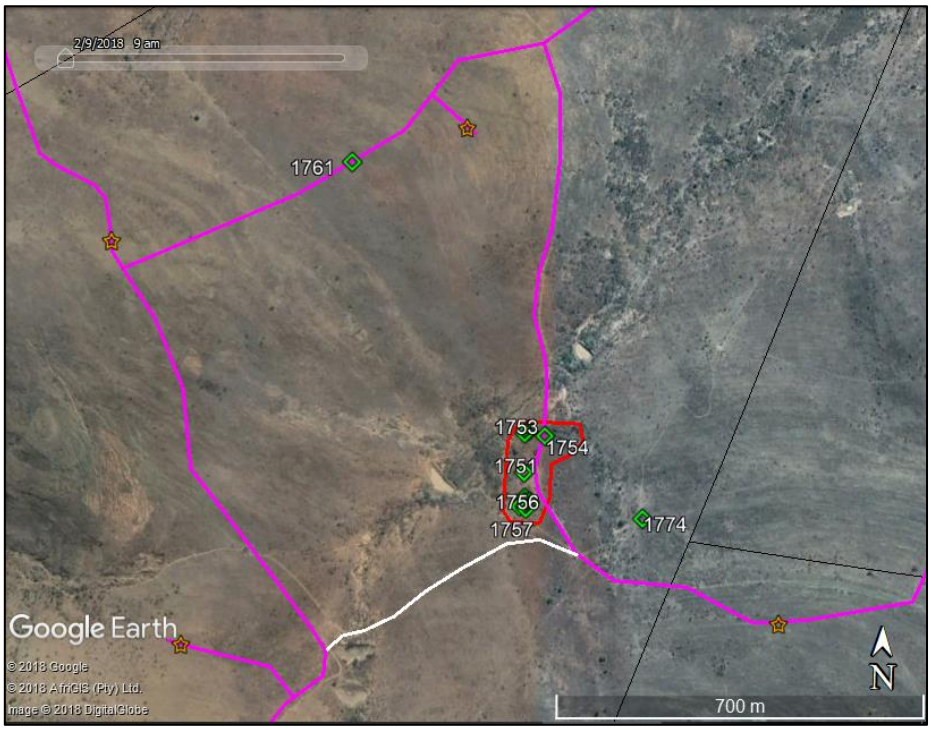

Figure 47: *Aerial view of the south-western part of the Highlands Central Phase 2 layout showing an area that might be avoided (red polygon) and a suggested alternative road alignment that might be considered (white line). Currently proposed roads are shown in pink.*

Although it will not be impacted because no infrastructure is currently planned there, it is worth noting that the large valley in the western part of the Highlands Central Phase 2 WEF (on Farm 105/1) should be avoided by any further alterations to the layout. There is an important archaeological site there and others may also occur. The location of the site is shown in Figure 48.

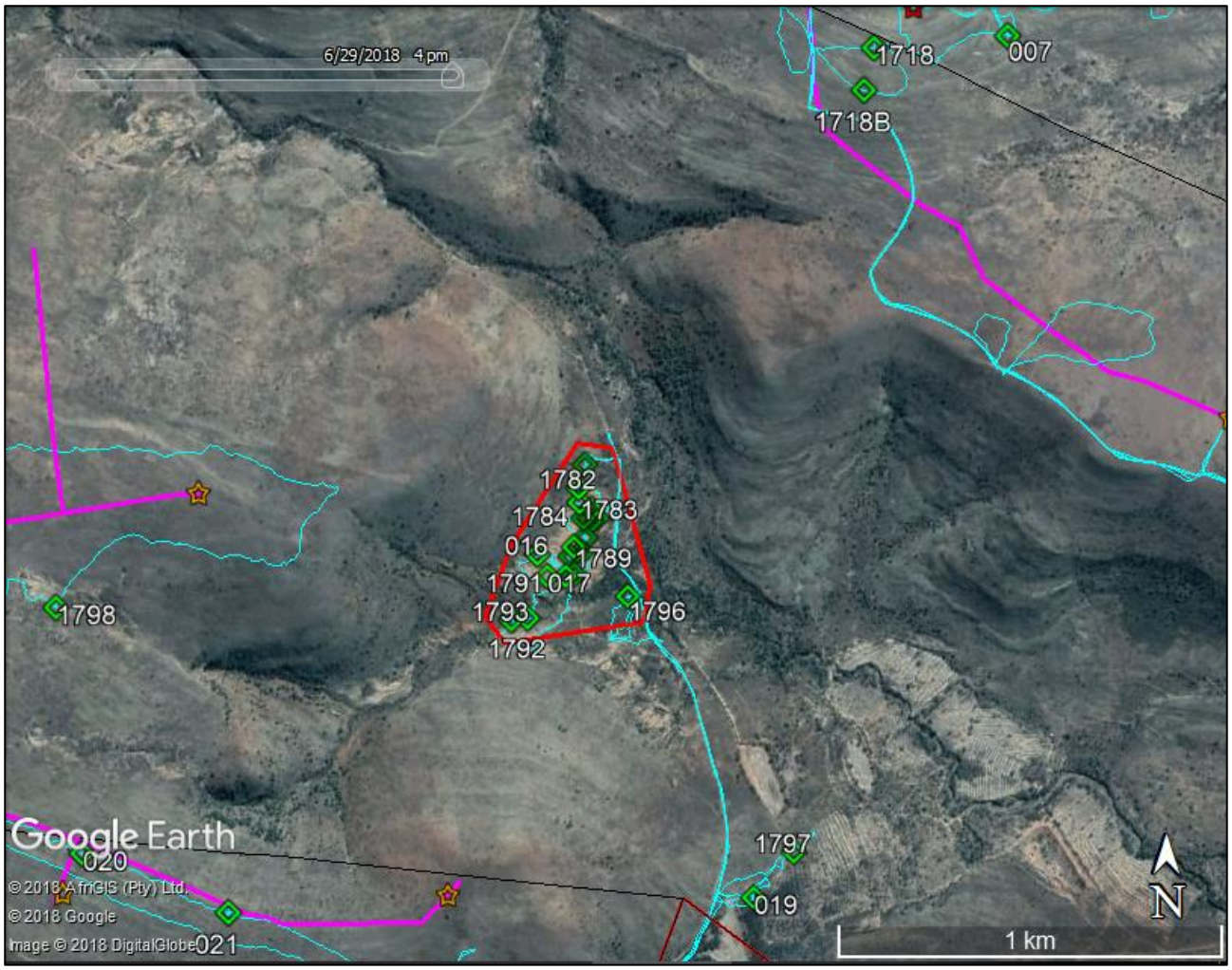

Figure 48: *Aerial view of the large valley on Farm 105/1 showing the location of an important archaeological site (red polygon).*

7.3. Existing impacts and levels of acceptable change

Palaeontological resources are subject to gradual deterioration through weathering and, when exposed at the surface, trampling by livestock. Archaeological artefacts are subject to trampling by livestock which results in damage to their edges. Natural erosion results in the slow deterioration of archaeological sites (especially deposits) and the sideways movement of artefacts. Graves are also subject to gradual erosion and weathering. Built heritage resources deteriorate slowly when not adequately maintained

Any impact to an archaeological or palaeontological resource or a grave is deemed unacceptable until such time as the resource has been inspected and studied further if necessary. Any alteration of or damage to built heritage resources of medium or higher cultural significance would be deemed unacceptable. Impacts to the landscape are difficult to quantify but in general a development that visually dominates the landscape from many vantage points is undesirable.

8. ASSESSMENT OF IMPACTS

It must be understood that the presently assessed layout was devised after the field survey and that the majority of the actual layout has not been looked at on the ground. As such, very few known heritage resources fall within or very close to the proposed project footprints. Four are located within the footprint and only two of these would require archaeological mitigation. The assessments thus provide a best estimate based on specialist knowledge of the heritage environment in the broader study area.

Notes (applicable to both the WEFs and grid connections):

- No assessment of impacts to built heritage resources is included because no impacts are expected.
- Impacts to archaeological resources and/or graves would only occur during the construction phase and thus no assessments for operation and decommissioning are provided.
- Impacts to the cultural landscape remain consistent throughout the lifespan of the project and would only cease after the decommissioning phase is complete and the land rehabilitated. The cultural landscape impact assessments provided thus cover construction, operation and decommissioning.

8.1. Highlands North Phase 1

8.1.1. Impacts to palaeontological resources

Significant impacts to fossil heritage are not expected based on current observations, although subsurface fossils may be revealed in excavations. The full impact assessment for palaeontology can be consulted in the specialist study included in Appendix 5 of the present report.

8.1.2. Impacts to archaeological resources

Table 2 assesses the impacts to archaeology. It is very likely that some archaeological materials will be directly impacted but highly unlikely that resources of high cultural significance would be affected. Because of the expected generally low cultural significance the intensity of expected impacts is rated as being low. The nature of the archaeology seen on site suggests that the extent of any impacts would never extend much beyond the site level so this was rated as low. Impacts to archaeological resources are permanent which leads to a duration of high. Although no archaeological sites are located within the project footprint areas, it is probable that some resources will be found when the actual alignments are surveyed. The calculated significance is **medium**.

With mitigation impacts would still definitely occur. However, the probability of impacts to culturally significant sites will drop to low with the impact significance reducing to **low**. There are no fatal flaws in terms of archaeology.

Table 2: *Assessment of archaeological impacts for Highlands North Phase 1.*

Impact Phase: Construction							
Potential impact description: Impacts on archaeological resources Detailed description of impact: Archaeological resources may be damaged or destroyed during clearing of the ground or excavation of foundations.							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	L	L	H	Negative	M	M	H
With Mitigation	L	L	H	Negative	L	L	H
Can the impact be reversed?			NO. Once archaeological artefacts are disturbed/destroyed the site cannot be recreated.				
Will impact cause irreplaceable loss or resources?			YES. Heritage resources are regarded as unique.				
Can impact be avoided, managed or mitigated?			YES. It is often easy to realign a section of road if needed but, if this is not possible then archaeological mitigation can be easily effected (there are no identified no-go areas within the present footprint).				
Mitigation measures to reduce residual risk or enhance opportunities: - Commission an archaeological walk-through survey to identify sites within final footprint - Carry out any archaeological mitigation for sites of cultural significance that cannot be avoided							

8.1.3. Impacts to graves

Table 3 assess the impacts to graves. It is very unlikely that graves will be impacted in any way because of their rarity on the landscape. Because of the high cultural significance of graves the intensity of impacts is rated as being high. The extent of any impacts would never extend much beyond the site level because people of regional or national importance are unlikely to be buried on the site. This was thus rated as low. Impacts to graves are permanent which leads to a duration of high. No graves are known to be located within the project footprint areas, it is highly improbable that any would be found when the actual alignments are surveyed or during construction (in the case of unmarked graves). The calculated significance is **medium**.

With mitigation the intensity drops to low and the resulting impact significance is **low**. There are no fatal flaws in terms of graves.

Table 3: *Assessment of impacts to graves for Highlands North Phase 1.*

Impact Phase: Construction							
Potential impact description: Impacts on graves Detailed description of impact: Graves may be damaged or destroyed during clearing of the ground or excavation of foundations.							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	H	L	H	Negative	L	M	H
With Mitigation	L	L	H	Negative	L	L	H
Can the impact be reversed?			NO. Once graves are disturbed/destroyed they cannot be recreated.				

Will impact cause irreplaceable loss or resources?	YES. Every grave is unique.
Can impact be avoided, managed or mitigated?	YES. It is often easy to realign a section of road if needed but, if this is not possible then exhumation can be effected (avoidance is strongly preferred).
Mitigation measures to reduce residual risk or enhance opportunities: - Commission an archaeological walk-through survey to identify graves within final footprint - Carry out exhumation of graves that cannot be avoided	

8.1.4. Impacts to the cultural landscape

Table 4 assess the impacts to the cultural landscape. Impacts to the cultural landscape are visual/contextual in nature and, if the project goes ahead, would definitely occur. The nature and cultural significance of the landscape suggests that medium intensity impacts would occur. Because turbines are visible from a great distance the extent is rated as medium. With decommissioning the impacts would cease to occur so the extent is seen as medium. The significance of this impact calculates to **medium**.

Although mitigation measures can be suggested to reduce the overall intensity of the impacts, these will have no real effect on the impact significance which remains **medium** after mitigation. There are no fatal flaws in terms of the cultural landscape.

Table 4: *Assessment of impacts to the cultural landscape for Highlands North Phase 1.*

Impact Phase: Construction / Operation / Decommissioning							
Potential impact description: Impacts to the cultural landscape Detailed description of impact: The cultural landscape would be altered through the addition of a new 'layer' comprising of large wind turbines and related infrastructure.							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	M	M	M	Negative	H	M	H
With Mitigation	M	M	M	Negative	H	M	H
Can the impact be reversed?			YES. If the facility is decommissioned and the land rehabilitated then the impacts would cease.				
Will impact cause irreplaceable loss or resources?			NO, because there are many other areas with very similar cultural landscape character.				
Can impact be avoided, managed or mitigated?			No, it is not possible to avoid the impacts. However, mitigation measures can very slightly reduce the severity of impacts.				
Mitigation measures to reduce residual risk or enhance opportunities: - Minimise cut and fill operations - Minimise unnecessary surface disturbance - Ensure effective rehabilitation of the development area after construction and again after decommissioning - Further measures would be as described by the visual assessment practitioner.							

8.2. Highlands Central Phase 2

8.2.1. Impacts to palaeontological resources

Significant impacts to fossil heritage are not expected based on current observations, although subsurface fossils may be revealed in excavations. The full impact assessment for palaeontology can be consulted in the specialist study included in Appendix 5 of the present report.

8.2.2. Impacts to archaeological resources

Table 5 assess the impacts to archaeology. It is very likely that some archaeological materials will be directly impacted but highly unlikely that resources of high cultural significance would be affected. Because two sites of medium cultural significance are already known to lie within the footprint, the intensity of expected impacts is rated as being medium. The nature of the archaeology seen on site suggests that the extent of any impacts would never extend much beyond the site level so this was rated as low. Impacts to archaeological resources are permanent which leads to a duration of high. Because two significant archaeological sites are known to occur within the project footprint area, the probability was rated high. The calculated significance is **medium**.

With mitigation impacts would still definitely occur but because known significant sites would have been mitigated the intensity becomes low. The probability of impacts to culturally significant sites will drop to low with the impact significance reducing to **low**. There are no fatal flaws in terms of archaeology.

Table 5: *Assessment of archaeological impacts for Highlands Central Phase 2.*

Impact Phase: Construction							
Potential impact description: Impacts on archaeological resources Detailed description of impact: Archaeological resources may be damaged or destroyed during clearing of the ground or excavation of foundations.							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	L	L	H	Negative	M	M	H
With Mitigation	L	L	H	Negative	L	L	H
Can the impact be reversed?	NO. Once archaeological artefacts are disturbed/destroyed the site cannot be recreated.						
Will impact cause irreplaceable loss or resources?	YES. Heritage resources are regarded as unique.						
Can impact be avoided, managed or mitigated?	YES. It is often easy to realign a section of road if needed but, if this is not possible then archaeological mitigation can be easily effected (there are no identified no-go areas within the present footprint).						
Mitigation measures to reduce residual risk or enhance opportunities: - Consider rerouting a section of access road in the south-western part of the study area - Commission an archaeological walk-through survey to identify sites within final footprint - Carry out any archaeological mitigation for sites of cultural significance that cannot be avoided. This includes excavation, sampling and recording of the historic midden at waypoint 1754							

8.2.3. Impacts to graves

Table 6 assess the impacts to graves. It is very unlikely that graves will be impacted in any way because of their rarity on the landscape. Because of the high cultural significance of graves the intensity of impacts is rated as being high. The extent of any impacts would never extend much beyond the site level because people of regional or national importance are unlikely to be buried on the site. This was thus rated as low. Impacts to graves are permanent which leads to a duration of high. No graves are known to be located within the project footprint areas, it is highly improbable that any would be found when the actual alignments are surveyed or during construction (in the case of unmarked graves). The calculated significance is **medium**.

With mitigation the intensity drops to low and the resulting impact significance is **low**. There are no fatal flaws in terms of graves.

Table 6: *Assessment of impacts to graves for Highlands Central Phase 2.*

Impact Phase: Construction							
Potential impact description: Impacts on graves Detailed description of impact: Graves may be damaged or destroyed during clearing of the ground or excavation of foundations.							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	H	L	H	Negative	L	M	H
With Mitigation	L	L	H	Negative	L	L	H
Can the impact be reversed?	NO. Once graves are disturbed/destroyed they cannot be recreated.						
Will impact cause irreplaceable loss or resources?	YES. Every grave is unique.						
Can impact be avoided, managed or mitigated?	YES. It is often easy to realign a section of road if needed but, if this is not possible then exhumation can be effected (avoidance is strongly preferred).						
Mitigation measures to reduce residual risk or enhance opportunities: - Commission an archaeological walk-through survey to identify graves within final footprint - Carry out exhumation of graves that cannot be avoided							

8.2.4. Impacts to the cultural landscape

Table 7 assess the impacts to the cultural landscape. Impacts to the cultural landscape are visual/contextual in nature and, if the project goes ahead, would definitely occur. The nature and cultural significance of the landscape suggests that medium intensity impacts would occur. Because turbines are visible from a great distance the extent is rated as medium. With decommissioning the impacts would cease to occur so the extent is seen as medium. The significance of this impact calculates to **medium**.

Although mitigation measures can be suggested to reduce the overall intensity of the impacts, these will have no real effect on the impact significance which remains **medium** after mitigation. There are no fatal flaws in terms of the cultural landscape.

Table 7: *Assessment of impacts to the cultural landscape for Highlands Central Phase 2.*

Impact Phase: Construction / Operation / Decommissioning							
Potential impact description: Impacts to the cultural landscape Detailed description of impact: The cultural landscape would be altered through the addition of a new 'layer' comprising of large wind turbines and related infrastructure.							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	M	M	M	Negative	H	M	H
With Mitigation	M	M	M	Negative	H	M	H
Can the impact be reversed?			YES. If the facility is decommissioned and the land rehabilitated then the impacts would cease.				
Will impact cause irreplaceable loss or resources?			NO, because there are many other areas with very similar cultural landscape character.				
Can impact be avoided, managed or mitigated?			No, it is not possible to avoid the impacts. However, mitigation measures can very slightly reduce the severity of impacts.				
Mitigation measures to reduce residual risk or enhance opportunities: - Minimise cut and fill operations - Minimise unnecessary surface disturbance - Ensure effective rehabilitation of the development area after construction and again after decommissioning - Further measures would be as described by the visual assessment practitioner.							

8.3. Highlands South Phase 3

8.3.1. Impacts to palaeontological resources

Significant impacts to fossil heritage are not expected based on current observations, although subsurface fossils may be revealed in excavations. The full impact assessment for palaeontology can be consulted in the specialist study included in Appendix 5 of the present report.

8.3.2. Impacts to archaeological resources

Table 8 assess the impacts to archaeology. It is very likely that some archaeological materials will be directly impacted but highly unlikely that resources of high cultural significance would be affected. Because of the expected generally low cultural significance the intensity of expected impacts is rated as being low. The nature of the archaeology seen on site suggests that the extent of any impacts would never extend much beyond the site level so this was rated as low. Impacts to archaeological resources are permanent which leads to a duration of high. Although no archaeological sites are located within the project footprint areas, it is probable that some resources will be found when the actual alignments are surveyed. The calculated significance is **medium**.

With mitigation impacts would still definitely occur. However, the probability of impacts to culturally significant sites will drop to low with the impact significance reducing to **low**. There are no fatal flaws in terms of archaeology.

Table 8: *Assessment of archaeological impacts for Highlands South Phase 3.*

Impact Phase: Construction							
Potential impact description: Impacts on archaeological resources Detailed description of impact: Archaeological resources may be damaged or destroyed during clearing of the ground or excavation of foundations.							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	L	L	H	Negative	M	M	H
With Mitigation	L	L	H	Negative	L	L	H
Can the impact be reversed?			NO. Once archaeological artefacts are disturbed/destroyed the site cannot be recreated.				
Will impact cause irreplaceable loss or resources?			YES. Heritage resources are regarded as unique.				
Can impact be avoided, managed or mitigated?			YES. It is often easy to realign a section of road if needed but, if this is not possible then archaeological mitigation can be easily effected (there are no identified no-go areas within the present footprint).				
Mitigation measures to reduce residual risk or enhance opportunities: - Commission an archaeological walk-through survey to identify sites within final footprint - Carry out any archaeological mitigation for sites of cultural significance that cannot be avoided							

8.3.3. Impacts to graves

Table 9 assess the impacts to graves. It is very unlikely that graves will be impacted in any way because of their rarity on the landscape. Because of the high cultural significance of graves the intensity of impacts is rated as being high. The extent of any impacts would never extend much beyond the site level because people of regional or national importance are unlikely to be buried on the site. This was thus rated as low. Impacts to graves are permanent which leads to a duration of high. No graves are known to be located within the project footprint areas, it is highly improbable that any would be found when the actual alignments are surveyed or during construction (in the case of unmarked graves). The calculated significance is **medium**.

With mitigation the intensity drops to low and the resulting impact significance is **low**. There are no fatal flaws in terms of graves.

Table 9: *Assessment of impacts to graves for Highlands South Phase 3.*

Impact Phase: Construction							
Potential impact description: Impacts on graves Detailed description of impact: Graves may be damaged or destroyed during clearing of the ground or excavation of foundations.							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	H	L	H	Negative	L	M	H
With Mitigation	L	L	H	Negative	L	L	H
Can the impact be reversed?			NO. Once graves are disturbed/destroyed they cannot be recreated.				

Will impact cause irreplaceable loss or resources?	YES. Every grave is unique.
Can impact be avoided, managed or mitigated?	YES. It is often easy to realign a section of road if needed but, if this is not possible then exhumation can be effected (avoidance is strongly preferred).
Mitigation measures to reduce residual risk or enhance opportunities: - Commission an archaeological walk-through survey to identify graves within final footprint - Carry out exhumation of graves that cannot be avoided	

8.3.4. Impacts to the cultural landscape

Table 10 assess the impacts to the cultural landscape. Impacts to the cultural landscape are visual/contextual in nature and, if the project goes ahead, would definitely occur. The nature and cultural significance of the landscape suggests that medium intensity impacts would occur. Because turbines are visible from a great distance the extent is rated as medium. With decommissioning the impacts would cease to occur so the extent is seen as medium. The significance of this impact calculates to **medium**.

Although mitigation measures can be suggested to reduce the overall intensity of the impacts, these will have no real effect on the impact significance which remains **medium** after mitigation. There are no fatal flaws in terms of the cultural landscape.

Table 10: *Assessment of impacts to the cultural landscape for Highlands South Phase 3.*

Impact Phase: Construction / Operation / Decommissioning							
Potential impact description: Impacts to the cultural landscape Detailed description of impact: The cultural landscape would be altered through the addition of a new 'layer' comprising of large wind turbines and related infrastructure.							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	M	M	M	Negative	H	M	H
With Mitigation	M	M	M	Negative	H	M	H
Can the impact be reversed?			YES. If the facility is decommissioned and the land rehabilitated then the impacts would cease.				
Will impact cause irreplaceable loss or resources?			NO, because there are many other areas with very similar cultural landscape character.				
Can impact be avoided, managed or mitigated?			No, it is not possible to avoid the impacts. However, mitigation measures can very slightly reduce the severity of impacts.				
Mitigation measures to reduce residual risk or enhance opportunities: - Minimise cut and fill operations - Minimise unnecessary surface disturbance - Ensure effective rehabilitation of the development area after construction and again after decommissioning - Further measures would be as described by the visual assessment practitioner.							

8.4. Highlands North, Central and South Phases 1-3 grid connections

No significant heritage resources have been identified within any of the corridors and all grid connection options would therefore have the same potential impacts. One set of impact assessments is thus supplied.

8.4.1. Impacts to palaeontology

Based on current observations, significant impacts to fossil heritage are not expected for the majority of the layout, although one important exposure was found in the Highlands North Alternative 2 grid connection alignment which would need to be avoided or mitigated as per the specialist recommendations. However, subsurface fossils may be revealed in excavations for pylons. The full impact assessment for palaeontology can be consulted in the specialist study included in Appendix 5 of the present report.

8.4.2. Impacts to archaeological resources

Table 11 assess the impacts to archaeology. It is very likely that some archaeological materials will be directly impacted but, given the very small footprints of power line pylons, highly unlikely that resources of high cultural significance would be affected. Because of the expected generally low cultural significance the intensity of expected impacts is rated as being low. The nature of the archaeology seen on site suggests that the extent of any impacts would never extend much beyond the site level so this was rated as low. Impacts to archaeological resources are permanent which leads to a duration of high. Although no significant archaeological sites are located within the project footprint areas, it is probable that some resources will be found when the actual alignments are surveyed but the probability of them being impacted is rated as low because of the small disturbance footprints involved. The calculated significance is **low**.

With mitigation impacts would still definitely occur. However, the probability of impacts to culturally significant sites remains low. The impact significance also remains **low**. There are no fatal flaws in terms of archaeology for any of the projects and alternatives.

Table 11: *Assessment of archaeological impacts for all three power line projects.*

Impact Phase: Construction							
Potential impact description: Impacts on archaeological resources Detailed description of impact: Archaeological resources may be damaged or destroyed during clearing of the ground or excavation of foundations.							
GRID ALTERNATIVE 1							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	L	L	H	Negative	L	L	H
With Mitigation	L	L	H	Negative	L	L	H

GRID ALTERNATIVE 2							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	L	L	H	Negative	L	L	H
With Mitigation	L	L	H	Negative	L	L	H
Can the impact be reversed?			NO. Once archaeological artefacts are disturbed/destroyed the site cannot be recreated.				
Will impact cause irreplaceable loss or resources?			YES. Heritage resources are regarded as unique.				
Can impact be avoided, managed or mitigated?			YES. It is often easy to realign a section of road if needed but, if this is not possible then archaeological mitigation can be easily effected (there are no identified no-go areas within the present footprint).				
Mitigation measures to reduce residual risk or enhance opportunities: - Commission an archaeological walk-through survey to identify sites within final footprint - Carry out any archaeological mitigation for sites of cultural significance that cannot be avoided							

8.4.3. Impacts to graves

Table 12 assess the impacts to graves. It is very unlikely that graves will be impacted in any way both because of their rarity on the landscape and the small footprint of the power line pylons. Because of the high cultural significance of graves the intensity of impacts is rated as being high. The extent of any impacts would never extend much beyond the site level because people of regional or national importance are unlikely to be buried on the site. This was thus rated as low. Impacts to graves are permanent which leads to a duration of high. No graves are known to be located within the project footprint areas, it is highly improbable that any would be found when the actual alignments are surveyed or during construction (in the case of unmarked graves). The calculated significance is **medium**.

With mitigation the intensity drops to low and the resulting impact significance is **low**. There are no fatal flaws in terms of graves.

Table 12: *Assessment of impacts to graves for all three power line projects.*

Impact Phase: Construction							
Potential impact description: Impacts on graves Detailed description of impact: Graves may be damaged or destroyed during clearing of the ground or excavation of foundations.							
GRID ALTERNATIVE 1							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	H	L	H	Negative	L	M	H
With Mitigation	L	L	H	Negative	L	L	H

GRID ALTERNATIVE 2							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	H	L	H	Negative	L	M	H
With Mitigation	L	L	H	Negative	L	M	H
Can the impact be reversed?			NO. Once graves are disturbed/destroyed they cannot be recreated.				
Will impact cause irreplaceable loss or resources?			YES. Every grave is unique.				
Can impact be avoided, managed or mitigated?			YES. It is often easy to realign a section of road if needed but, if this is not possible then exhumation can be effected (avoidance is strongly preferred).				
Mitigation measures to reduce residual risk or enhance opportunities: - Commission an archaeological walk-through survey to identify graves within final footprint - Carry out exhumation of graves that cannot be avoided							

8.4.4. Impacts to the cultural landscape

Table 13 assess the impacts to the cultural landscape. Impacts to the cultural landscape are visual/contextual in nature and, if the project goes ahead, would definitely occur. The nature and cultural significance of the landscape suggests that low intensity impacts would occur. Because power lines are not visible from a great distance the extent is rated as medium. With decommissioning the impacts would cease to occur so the extent is seen as medium. The significance of this impact calculates to **medium**.

There are no mitigation measures that can be applied and the impact significance therefore remains **medium** after mitigation. There are no fatal flaws in terms of the cultural landscape.

Table 13: *Assessment of impacts to the cultural landscape for all three power line projects.*

Impact Phase: Construction / Operation / Decommissioning							
Potential impact description: Impacts to the cultural landscape Detailed description of impact: The cultural landscape would be altered through the addition of a new 'layer' comprising of large wind turbines and related infrastructure.							
GRID ALTERNATIVE 1							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	L	L	M	Negative	H	M	H
With Mitigation	L	L	M	Negative	H	M	H
GRID ALTERNATIVE 2							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	L	L	M	Negative	H	M	H
With Mitigation	L	L	M	Negative	H	M	H
Can the impact be reversed?			YES. If the facility is decommissioned and the land rehabilitated then the impacts would cease.				

Will impact cause irreplaceable loss or resources?	NO, because there are many other areas with very similar cultural landscape character.
Can impact be avoided, managed or mitigated?	No, it is not possible to avoid the impacts. However, mitigation measures can very slightly reduce the severity of impacts.
Mitigation measures to reduce residual risk or enhance opportunities: - Minimise cut and fill operations - Minimise unnecessary surface disturbance - Ensure effective rehabilitation of the development area after construction and again after decommissioning - Further measures would be as described by the visual assessment practitioner.	

8.5. Cumulative impacts

This section broadly assesses the impacts to the same types of heritage resources for which impacts have been assessed above. Only four other projects from within a 35 km radius are known. These are the proposed Middleton Wind Energy Project and three proposed Solar PV projects near Pearston. In general heritage information from the area is very limited and the cumulative assessment below is thus based partly on the author's specialist knowledge of the landscape and the likely distribution of heritage resources within it.

8.5.1. Impacts to palaeontology

Based on current observations, significant impacts to fossil heritage are not expected for the majority of the layout, although one important exposure was found in the Highlands North Alternative 2 grid connection alternative. However, subsurface fossils may be revealed in excavations for pylons. The full impact assessment for palaeontology can be consulted in the specialist study included in Appendix 5 of the present report.

8.5.2. Impacts to archaeological resources

Table 14 assess the potential cumulative impacts to archaeology. It is very likely that some archaeological materials will be directly impacted by most similar developments in the broader area. However, due to the types of landscape targeted for development and the buffers typically imposed around rivers and wetlands where archaeology is most common, it is unlikely that resources of high cultural significance would be affected. The intensity of expected cumulative impacts to archaeology is rated as being low. Again, the type of archaeological remains likely to be encountered in similar developments is unlikely to have significance beyond the site level so extent was rated as low. Impacts to archaeological resources are permanent which leads to a duration of high. The calculated significance is **medium**.

As is the case for the present project, mitigation should be easily effected where avoidance is not possible. With mitigation impacts would still definitely occur. However, the probability of impacts to culturally significant sites will drop to low with the impact significance reducing to **low**. There are no fatal flaws in terms of cumulative impacts to archaeology.

Table 14: *Assessment of cumulative archaeological impacts for all six Highlands projects and surrounding projects.*

Impact Phase: Construction

Potential impact description: Impacts on archaeological resources Detailed description of impact: Archaeological resources may be damaged or destroyed during clearing of the ground or excavation of foundations.							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	L	L	H	Negative	M	M	H
With Mitigation	L	L	H	Negative	L	L	H
Can the impact be reversed?			NO. Once archaeological artefacts are disturbed/destroyed the site cannot be recreated.				
Will impact cause irreplaceable loss or resources?			YES. Heritage resources are regarded as unique.				
Can impact be avoided, managed or mitigated?			YES. It is often easy to realign a section of road if needed but, if this is not possible then archaeological mitigation can be easily effected (there are no identified no-go areas within the present footprint).				
Mitigation measures to reduce residual risk or enhance opportunities: - Commission an archaeological walk-through survey to identify sites within final footprints - Carry out any archaeological mitigation for sites of cultural significance that cannot be avoided							

8.5.3. Impacts to graves

Table 15 assess the potential cumulative impacts to graves. It is very unlikely that graves will be impacted during similar large developments because of their rarity on the landscape and, as is the case with archaeology, their likely greater density in river valleys. Because of the high cultural significance of graves the intensity of impacts would nevertheless be high. The extent of any impacts would not extend beyond the site level because people of regional or national importance are unlikely to be buried on the kinds of sites targeted for renewable energy developments. This was thus rated as low. Impacts to graves are permanent which leads to a duration of high. It is considered highly improbable that graves would be found in development areas and the calculated significance is **medium**.

With mitigation the intensity drops to low and the resulting impact significance is **low**. There are no fatal flaws in terms of graves.

Table 15: *Assessment of cumulative impacts to graves for all six Highlands projects and surrounding projects.*

Impact Phase: Construction							
Potential impact description: Impacts on graves Detailed description of impact: Graves may be damaged or destroyed during clearing of the ground or excavation of foundations.							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	H	L	H	Negative	L	M	H
With Mitigation	L	L	H	Negative	L	L	H
Can the impact be reversed?			NO. Once graves are disturbed/destroyed they cannot be recreated.				

Will impact cause irreplaceable loss or resources?	YES. Every grave is unique.
Can impact be avoided, managed or mitigated?	YES. It is often easy to realign a section of road if needed but, if this is not possible then exhumation can be effected (avoidance is strongly preferred).
Mitigation measures to reduce residual risk or enhance opportunities: - Commission an archaeological walk-through survey to identify graves within final footprint - Carry out exhumation of graves that cannot be avoided	

8.5.4. Impacts to the cultural landscape

Table 16 assesses the potential cumulative impacts to the cultural landscape. Impacts to the cultural landscape are visual/contextual in nature and, if development goes ahead, would definitely occur. The nature and cultural significance of the landscape and small number of similar developments proposed for the area suggests that impacts of no greater than medium intensity would occur. Because turbines are visible from a great distance the extent is rated as medium. With decommissioning the impacts would cease to occur so the extent is seen as medium. The significance of this impact calculates to **medium**.

Although mitigation measures can be suggested to reduce the overall intensity of the impacts, these will have no real effect on the impact significance which remains **medium** after mitigation. There are no fatal flaws in terms of the cultural landscape, especially since the area is a REDZ which encourages an accumulation of impacts in one area (admittedly far larger than the area considered for this assessment) and discourages a widespread proliferation of impacts across the wider landscape.

Table 16: *Assessment of impacts to the cultural landscape for all six Highlands projects and surrounding projects.*

Impact Phase: Construction / Operation / Decommissioning							
Potential impact description: Impacts to the cultural landscape Detailed description of impact: The cultural landscape would be altered through the addition of a new 'layer' comprising of large wind turbines and or solar PV arrays and related infrastructure.							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	M	M	M	Negative	H	M	H
With Mitigation	M	M	M	Negative	H	M	H
Can the impact be reversed?			YES. If developments are decommissioned and the land rehabilitated then the impacts would cease.				
Will impact cause irreplaceable loss or resources?			NO, because there are many other areas with very similar cultural landscape character.				
Can impact be avoided, managed or mitigated?			No, it is not possible to avoid the impacts. However, mitigation measures can very slightly reduce the severity of impacts.				
Mitigation measures to reduce residual risk or enhance opportunities: - Minimise cut and fill operations - Minimise unnecessary surface disturbance - Ensure effective rehabilitation of the development area after construction and again after decommissioning - Further measures would be as described by the visual assessment practitioner.							

9. EVALUATION OF IMPACTS RELATIVE TO SUSTAINABLE SOCIAL AND ECONOMIC BENEFITS

Section 38(3)(d) of the NHRA requires an evaluation of the impacts on heritage resources relative to the sustainable social and economic benefits to be derived from the development.

The provision of a reliable electricity supply in South Africa, both for the sake of domestic and commercial/industrial use, is seen as important. It is for this reason that the REDZs were gazetted. The proposed project will contribute clean energy to South Africa's electricity supply which is seen as a positive social and economic impact. A small number of jobs is likely to be created in the long term. The impacts to heritage resources are not significant enough to outweigh the social and economic impacts to be realised by the proposed project.

10. CONCLUSIONS

The fieldwork for this project shows that archaeological resources could be found almost anywhere in the overall project area but that the vast majority are likely to be of low cultural significance. Aside from impacts to the cultural landscape which are unavoidable but only of generally medium significance, no other aspects of heritage are expected to be impacted. Although a further survey will be required prior to the commencement of construction, it is considered highly unlikely that heritage resources that would require avoidance will be found. Rather, it is likely that some archaeological mitigation may be needed for any resources that cannot be avoided. Such mitigation can be easily effected where required. The proposed realignment of the southern access road is strongly supported as this will reduce the potential for impacts in this area.

It can thus be concluded that the six proposed projects – three WEFs and associated infrastructure and three powerlines – will not have significant impacts on heritage resources that cannot be mitigated and, from a heritage perspective, can be supported. Only the Highlands Central Phase 2 WEF currently has archaeological mitigation requirements but these are minor and of no consequence to decision-making.

After completion of the assessment presented above, the proponent reworked the layout in order to put effect to the mitigation suggestions of the various specialists and achieve a more favourable layout for purposes of the environmental application. A realignment measure suggested for heritage purposes in order to reduce mitigation requirements was:

- The possible realignment of a section of access road in the south-western part of the Highlands Central Phase 2 study area should be considered as shown in Figure 47 above.

This realignment was included in the final layout, although the original route through a small farmstead was retained as an option. This option remains undesirable from a heritage point of view and, if implemented, would require the mitigation listed below for the waypoints 1751-1758 area. With this option abandoned completely all requirements around these waypoints would fall away completely.

The archaeological site at waypoint 1761 has been avoided by the final layout and the initial mitigation requirement has fallen away.

11. RECOMMENDATIONS

It is recommended that the all three proposed WEFs and all three proposed power lines (using any alternatives) be allowed to proceed but subject to the following conditions which should be incorporated into the environmental authorisation of each of the six projects as appropriate:

- Monitoring of all substantial excavations (e.g. wind turbine foundations) for fossil material on an on-going basis during construction phase;
- Application of Chance Fossil Finds Procedure (See Appendix 2 of palaeontological specialist study): safeguarding new fossil finds and reporting to ECPHRA by ECO for possible recording and sampling by professional palaeontologist;
- The access road via Farm 105/rem must not be used;
- The large valley on Farm 105/1 must be avoided; especially the archaeological site between waypoints 1781, 1793 and 1796;
- A minimum 30 m buffer to be maintained around all graves, ruins and buildings (but note possible exception in next recommendation);
- If the internal road alignment through the waypoints 1751-1758 area is used then the various heritage features there are to be cordoned off for their protection with the largest buffers possible and waypoint 1754 will require archaeological excavation work to sample and record the historical midden (Highlands Central Phase 2);
- The fence incorporating historical stone fence posts (waypoint 1720 lies on this fence line) should be avoided if possible (Highlands North Phase 1 and Central Phase 2);
- A final walk-down survey of the authorised footprints and alignments for all six projects should be carried out at least 6 months before the start of construction in order for any archaeological mitigation requirements to be determined and carried out;
- If any archaeological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

12. REFERENCES

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Schoeman, C. 2013. The historical Karoo: traces of the past in South Africa's arid interior. Zebra Press: Cape Town.

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APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

Address: 40 Brassie Street, Lakeside, 7945
Telephone: (021) 788 8425
Cell Phone: 083 272 3225
Email: jayson@asha-consulting.co.za

Birth date and place: 22 June 1976, Cape Town, South Africa
Citizenship: South African
ID no: 760622 522 4085
Driver's License: Code 08
Marital Status: Married to Carol Orton
Languages spoken: English and Afrikaans

Education:

SA College High School	Matric	1994
University of Cape Town	B.A. (Archaeology, Environmental & Geographical Science)	1997
University of Cape Town	B.A. (Honours) (Archaeology)*	1998
University of Cape Town	M.A. (Archaeology)	2004
University of Oxford	D.Phil. (Archaeology)	2013

*Frank Schweitzer memorial book prize for an outstanding student and the degree in the First Class.

Employment History:

Spatial Archaeology Research Unit, UCT	Research assistant	Jan 1996 – Dec 1998
Department of Archaeology, UCT	Field archaeologist	Jan 1998 – Dec 1998
UCT Archaeology Contracts Office	Field archaeologist	Jan 1999 – May 2004
UCT Archaeology Contracts Office	Heritage & archaeological consultant	Jun 2004 – May 2012
School of Archaeology, University of Oxford	Undergraduate Tutor	Oct 2008 – Dec 2008
ACO Associates cc	Associate, Heritage & archaeological consultant	Jan 2011 – Dec 2013
ASHA Consulting (Pty) Ltd	Director, Heritage & archaeological consultant	Jan 2014 –

Professional Accreditation:

Association of Southern African Professional Archaeologists (ASAPA) membership number: 233
CRM Section member with the following accreditation:

- Principal Investigator: Coastal shell middens (awarded 2007)
  Stone Age archaeology (awarded 2007)
  Grave relocation (awarded 2014)
- Field Director: Rock art (awarded 2007)
  Colonial period archaeology (awarded 2007)

Association of Professional Heritage Practitioners (APHP) membership number: 43

- Accredited Professional Heritage Practitioner

➢ *Memberships and affiliations:*

South African Archaeological Society Council member	2004 – 2016
Assoc. Southern African Professional Archaeologists (ASAPA) member	2006 –
UCT Department of Archaeology Research Associate	2013 –
Heritage Western Cape APM Committee member	2013 –
UNISA Department of Archaeology and Anthropology Research Fellow	2014 –
Fish Hoek Valley Historical Association	2014 –
Kalk Bay Historical Association	2016 –
Association of Professional Heritage Practitioners member	2016 –

Fieldwork and project experience:

Extensive fieldwork and experience as both Field Director and Principle Investigator throughout the Western and Northern Cape, and also in the western parts of the Free State and Eastern Cape as follows:

Feasibility studies:

- Heritage feasibility studies examining all aspects of heritage from the desktop

Phase 1 surveys and impact assessments:

- Project types
  - Notification of Intent to Develop applications (for Heritage Western Cape)
  - Desktop-based Letter of Exemption (for the South African Heritage Resources Agency)
  - Heritage Impact Assessments (largely in the Environmental Impact Assessment or Basic Assessment context under NEMA and Section 38(8) of the NHRA, but also self-standing assessments under Section 38(1) of the NHRA)
  - Archaeological specialist studies
  - Phase 1 archaeological test excavations in historical and prehistoric sites
  - Archaeological research projects
- Development types
  - Mining and borrow pits
  - Roads (new and upgrades)
  - Residential, commercial and industrial development
  - Dams and pipe lines
  - Power lines and substations
  - Renewable energy facilities (wind energy, solar energy and hydro-electric facilities)

Phase 2 mitigation and research excavations:

- ESA open sites
  - Duinefontein, Gouda, Namaqualand
- MSA rock shelters
  - Fish Hoek, Yzerfontein, Cederberg, Namaqualand
- MSA open sites
  - Swartland, Bushmanland, Namaqualand
- LSA rock shelters
  - Cederberg, Namaqualand, Bushmanland
- LSA open sites (inland)
  - Swartland, Franschhoek, Namaqualand, Bushmanland
- LSA coastal shell middens
  - Melkbosstrand, Yzerfontein, Saldanha Bay, Paternoster, Dwarskersbos, Infanta, Knysna, Namaqualand
- LSA burials
  - Melkbosstrand, Saldanha Bay, Namaqualand, Knysna
- Historical sites
  - Franschhoek (farmstead and well), Waterfront (fort, dump and well), Noordhoek (cottage), variety of small excavations in central Cape Town and surrounding suburbs
- Historic burial grounds
  - Green Point (Prestwich Street), V&A Waterfront (Marina Residential), Paarl

Awards:

Western Cape Government Cultural Affairs Awards 2015/2016: Best Heritage Project.

APPENDIX 2 – Declaration of Independence

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

The Proposed Highlands North, Central and South Wind Energy Facilities and associated grid connections, Eastern Cape Province

Specialist:	ASHA Consulting (Pty) Ltd		
Contact person:	Dr Jayson Orton		
Postal address:	P.O. Box 46, Noordhoek		
Postal code:	7979	Cell:	083 272 3225
Telephone:	021 789 0327	Fax:	n/a
E-mail:	jayson@asha-consulting.co.za		
Professional affiliation(s) (if any)	ASAPA CRM accreditation No. 233 APHP professional member No. 047		

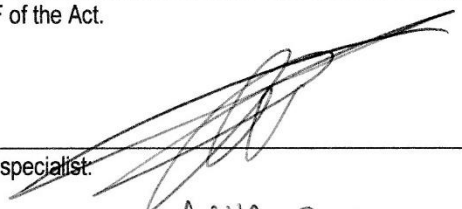
Project Consultant:	Arcus Consultancy Services South Africa (Ltd) Pty		
Contact person:	Ashlin Bodasing		
Postal address:	Cube Workspace, Long Street & Hans Strijdom Ave, Cape Town		
Postal code:	8001	Cell:	076 340 8914
Telephone:	021 412 1529	Fax:	086 609 7327
E-mail:	ashlinb@arcusconsulting.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, JAYSON ORTON , declare that --

General declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the specialist:

ASHA CONSULTING (PTY) LTD

Name of company (if applicable):

29 JUNE 2018

Date:

APPENDIX 3 – List of heritage sites recorded during the survey

In the significance column those sites within, or within *c.* 5 m of, the current WEF footprints (including road alignments and other related infrastructure) and that will likely be impacted are highlighted in red. Those that lie very close to the WEF layout (within *c.* 20 m of the roads and other related infrastructure) and that might be impacted if care is not taken are highlighted in orange. Blue highlights indicate those sites falling within the power line corridors.

Waypoint	Co-ordinates	Description	Significance
1710	S32 40 58.9 E25 21 42.6	Kraal and ruin complex of mud bricks and stones. Not fully recorded because outside of study area. Feature on south side may be a grave.	Medium
1712	S32 41 57.8 E25 22 26.8	Light scatter of dark green wine bottle glass, some pieces of which look flaked.	Low
1713	S32 42 18.1 E25 23 10.9	Small 'pile' of rocks at the edge of a small plateau. Unknown function.	Low
1714	S32 42 18.4 E25 23 13.3	Light scatter of pale green bottle glass. Bubbles in glass show that it is not modern glass.	Low
1715	S32 41 56.7 E25 22 43.6	Light scatter of artefacts in a sandy area including one handaxe. Materials probably hornfels or baked sandstone. Very patinated and weathered.	Low
1716	S32 41 58.0 E25 22 43.5	Light scatter of artefacts in a gravel area. Materials probably hornfels or baked sandstone. Very patinated and weathered.	Low
1717	S32 42 17.3 E25 22 46.7	Rippled surface in stream bed. To be dealt with in palaeontological study.	---
1718	S32 43 23.7 E25 22 21.9	Old fence line. All that remains is a line of stones along the alignment of the fence. Cannot tell if this is old or recent because the practice of lining the bases of fences continues today.	Low
1718B	S32 43 27.0 E25 22 20.9		
1719	S32 43 03.5 E25 21 33.3	New fence that incorporates old stone fence posts.	Low
1720	S32 42 49.3 E25 20 02.0	New fence that incorporates old stone fence posts.	Low
1721	S32 44 43.9 E25 22 06.1	Stone-built and pointed entrance pillars to Doornrivier.	Low
1722	S32 44 45.6 E25 22 04.5	Large Victorian farmhouse that burnt down and has been partly demolished. Although built with low-fired red clay bricks and mud mortar, it incorporates concrete lintels. It has a stoep on the east and north sides with pillars. North end has been enclosed to create a sun room in c. mid-20th century and has modern bricks and cement and steel-framed windows. The original front door faces east but a new flight of steps has been added to the north side when the stoep was enclosed. The whole house stands on a stone plinth which has buttresses around the north-eastern corner. The entire east facing façade is present and some of the north and south walls but whole rear (west) and most inner walls are demolished and removed.	Medium
1723	S32 44 46.2 E25 22 04.1	Late 19th century outbuilding built, extended and repaired in phases. At least part is on a stone plinth.	Medium

1724	S32 44 46.9 E25 22 02.6	Large mid-20th century double storey outbuilding with steel-framed windows. Floor boards are stamped underneath with "FROM KOHLER BROS, PE." And "J.R. BOSCH OF DOORN RIVIER SOMERSET EAST"	Low-Medium
1725	S32 44 46.7 E25 22 01.5	Late 19th century shed built on a stone plinth. There is a newer lean-to on the north side. The large room in the west end has a flagstone floor and internal hearth. A steel-framed window appears on the south face. It and other features are later alterations.	Medium
1726	S32 44 47.8 E25 22 00.9	Presumably the original farmhouse. A c. mid-19th century long house with a stope along the front (north) side. Original house had no stoep but a flight of stairs. Sagging of newer stoep visible around buried stairs. The house has been extended towards the east with a Karoostyle flat roofed room. There are mid-20th century additions to the rear (south) and new doors were made through from original house to the new rooms at the back. Note: There are various features visible on the hill behind the Doornrivier farm complex which were not examined.	Medium
1727	S32 44 42.3 E25 21 56.6	Stone labourer's cottage which has had its walls raised with brick and a new roof added.	Medium
1728	S32 44 44.0 E25 21 55.8	c. late 19th century brick and mud mortar cottage with wooden lintels and joinery. It is on a stone plinth and has had an extension added to its eastern end. A refrigerator stands inside the house with "SERVEL KEROSENSE REFRIGERATOR" on it. These were made between 1927 and 1956 (White 2017).	Medium
1729	S32 44 44.1 E25 21 54.6	Large stone kraal complex that has had modern corrugated iron roofs built over parts of it.	Medium
1729B	S32 44 45.5 E25 21 54.0		
1730	S32 44 47.3 E25 21 58.2	Area with a light scatter of historical glass and ceramics. There are also a few stone artefacts here too.	Low
1731	S32 44 50.1 E25 21 57.5	Stone and clay brick ruin. Includes a hearth and chimney stack and a *muurkas*.	Low-medium
1732	S32 44 50.7 E25 21 58.4	Renovated and extended historical cottage. Hearth and chimney stack, steel-framed windows. Not examined in detail.	Low-medium
1733	S32 45 00.7 E25 21 50.9	Scatter of LSA artefacts including some adzes.	Medium
1734	S32 44 59.7 E25 21 50.3		
1740	S32 44 59.6 E25 21 48.9	Further area of LSA artefacts.	
1741	S32 45 01.3 E25 21 51.3	Further area of LSA artefacts.	
1742	S32 44 59.6 E25 21 51.0	Further area of LSA artefacts.	
1735	S32 44 58.5 E25 21 50.7	Spring in the river around which the LSA archaeology occurs.	---
1736	S32 44 58.0 E25 21 50.1	A short section of stone walling of indeterminate function.	Low
1737	S32 44 54.2 E25 21 48.8	A stone-built terrace, perhaps a road leading up the hill.	
1738	S32 44 53.7 E25 21 45.8		
1739		Small dam built in river on a small cliff. Mid-20th century.	Low
1743	S32 44 54.9 E25 21 38.6	Historical quarry site where stone was removed for the houses.	Low
1744	S32 44 53.4 E25 21 27.4	LSA site on a flat area above a river. A lower grindstone was seen at this point.	Low-medium
1745	S32 44 52.5 E25 21 27.4	Same site as above.	
1746	S32 44 52.6 E25 21 26.7	Same site as above. Grave-like stone mound occurs here.	

1747	S32 44 50.9 E25 21 28.7	Same site as above.	
1749	S32 44 54.0 E25 21 26.2	Same site as above.	
1750	S32 44 54.5 E25 21 25.4	Same site as above. Some ostrich eggshell fragments seen here.	
009	S32 44 53.1 E25 21 28.9	Mid-point between two stone heaps, possible burials, in donga area. Artificial concentration of dolerite slabs and clasts.	
010	S32 44 52.7 E25 21 29.1	Possible burial in same donga area.	
011	S32 44 52.4 E25 21 29.1	Possible burial in same area as 010 and 011.	
1748	S32 44 51.3 E25 21 31.2	Historical stone quarry. A metal rod (possibly part of an axle) has been left in between rocks where it was used as a wedge.	Low
1751	S32 44 18.8 E25 20 14.3	Small longhouse that has had two additions to it and the roof raised. It has largely collapsed. Low inherent significance.	Low
1752	S32 44 16.2 E25 20 14.6	Likely grave that appears as a single headstone only.	High
1753	S32 44 16.4 E25 20 14.3	Likely grave that appears as a single headstone only. A broken lower grindstone was noted near these two graves.	High
1754	S32 44 16.5 E25 20 15.8	Historical ash dump with much glass, ceramic and bone in it.	Medium [MITIGATE]
1755	S32 44 20.3 E25 20 14.4	Collapsed dolerite kraal. Four points (1755-1758) mark the four corners.	
1756	S32 44 21.0 E25 20 14.5		
1757	S32 44 20.9 E25 20 14.1		
1758	S32 44 20.6 E25 20 14.8		
1759	S32 43 35.6 E25 19 04.2	Light background artefact scatter including a radial core.	Low
1760	S32 43 28.1 E25 19 05.2	A quartz outcrop with one large block showing flaking along its edges. The quartz is very poor quality.	Low
1761	S32 44 00.0 E25 20 01.2	A hornfels artefact scatter. Most artefacts likely to be LSA. It is possible that it is here because an outcrop of good stone was present.	Medium [MITIGATE]
1762	S32 44 36.9 E25 20 16.7	A large kraal complex with four enclosures. The western two are the original kraal with the two western enclosures added later. Built with two skins and rubble fill. It is still in quite good condition. The waypoints represent the intersections of the various walls.	Medium
1763	S32 44 36.9 E25 20 16.2		
1764	S32 44 36.9 E25 20 15.6		
1765	S32 44 36.8 E25 20 15.1		
1766	S32 44 36.7 E25 20 14.6		
1767	S32 44 37.4 E25 20 14.7		
1768	S32 44 37.5 E25 20 15.2		
1769	S32 44 37.5 E25 20 15.7		
1770	S32 44 37.6 E25 20 16.2		
1771	S32 44 37.7 E25 20 16.6		
1772	S32 44 37.9 E25 20 16.4	Small stone pile of indeterminate function.	Low
1773	S32 44 37.9 E25 20 15.1	Small stone pile of indeterminate function.	Low

1774	S32 44 21.4 E25 20 23.1	Small stone ruin of about 3x5 m. The remaining walls are only about 0.5 m high.	Low
1775	S32 44 51.8 E25 21 22.1	Drystone retaining wall built across a stream to create a low water bridge-type structure.	Low
1776	S32 44 50.5 E25 21 54.4	Possible grave represented by a single headstone only. Very bushy area close to graveyard.	Unknown but High if a grave.
1777	S32 44 50.9 E25 21 54.1	Possible grave represented by a single headstone only. Very bushy area close to graveyard.	Unknown but High if a grave.
1778	S32 44 50.9 E25 21 51.5	Bosch family graveyard. Three dated graves are 1894, 1901 and 1917. These three lie within a smaller enclosure with brick corner posts and palisade fencing. The palisade fence has "JOSEPH LEWIS MAKER PORT ELIZABETH' on it.	High
1779	S32 44 54.3 E25 21 54.9	Stone-built feature that looks like a sheep dig but has a section built in the middle of the circular part.	Low
1780	S32 44 40.1 E25 22 01.7	Small stone retaining wall to create a low water bridge. The stones have been cemented.	Low
1781	S32 43 57.0 E25 21 54.3	Widespread background artefact scatter in a large eroding area.	High [AVOID] (most individual points are Low but collectively and with graves present the site is of High significance)
1782	S32 43 58.9 E25 21 53.7	Widespread background artefact scatter in the same large eroding area.	
1783	S32 44 00.1 E25 21 53.8	Widespread background artefact scatter in the same large eroding area. Also a lower grindstone seen here.	
1784	S32 44 00.7 E25 21 54.9	Two piles of stones in the above eroding area that may represent stone-packed graves.	
1785	S32 44 01.4 E25 21 55.5	A mound of soil packed with stones in the same eroding area. This must be a grave. Seems to have a north-south orientation. Many stone artefacts around here too.	
1786	S32 44 01.4 E25 21 54.1	A pile of stones in an erosion gully in the same eroding area. This must be a grave. Seems to have a north-south orientation. Many stone artefacts around here too.	
1787	S32 44 01.7 E25 21 54.8	An area of packed stones that looks more historical (e.g. erosion control measure) but given the context and lack of similar erosion control features is more likely another grave. Seems to have an east-west orientation. Many stone artefacts around here too.	
1788	S32 44 03.0 E25 21 54.3	A smaller cluster of stones than the above few and located in the same large eroding area. No obvious orientation.	
1789	S32 44 03.8 E25 21 53.2	A somewhat denser scatter of fresh hornfels flakes. There is also a lower grindstone close to this point.	
1790	S32 44 04.6 E25 21 52.9	Background scatter but with a lower grindstone located in this area.	
1791	S32 44 06.2 E25 21 52.4	A somewhat dense artefact scatter in the southern part of the same eroding area.	
1792	S32 44 09.7 E25 21 48.6	Extensive moderate density artefact scatter just above a small 'waterfall' in the river to the south of the main large eroding area.	
1793	S32 44 09.8 E25 21 47.0	Stone mound in a bushy area. There is also a double-sided lower grindstone about 3 m away.	
1795	S32 44 04.2 E25 21 54.0	Background artefact scatter but with a small lower grindstone here. Possible second lower grindstone in the area too.	
1796	S32 44 07.9 E25 21 58.5	A mound of soil packed with stones. This must be a grave. It is approximately circular and has no obvious orientation.	
017	S32 44 06.2 E25 21 50.6	Lower grindstone in same donga area as 014 to 016.	

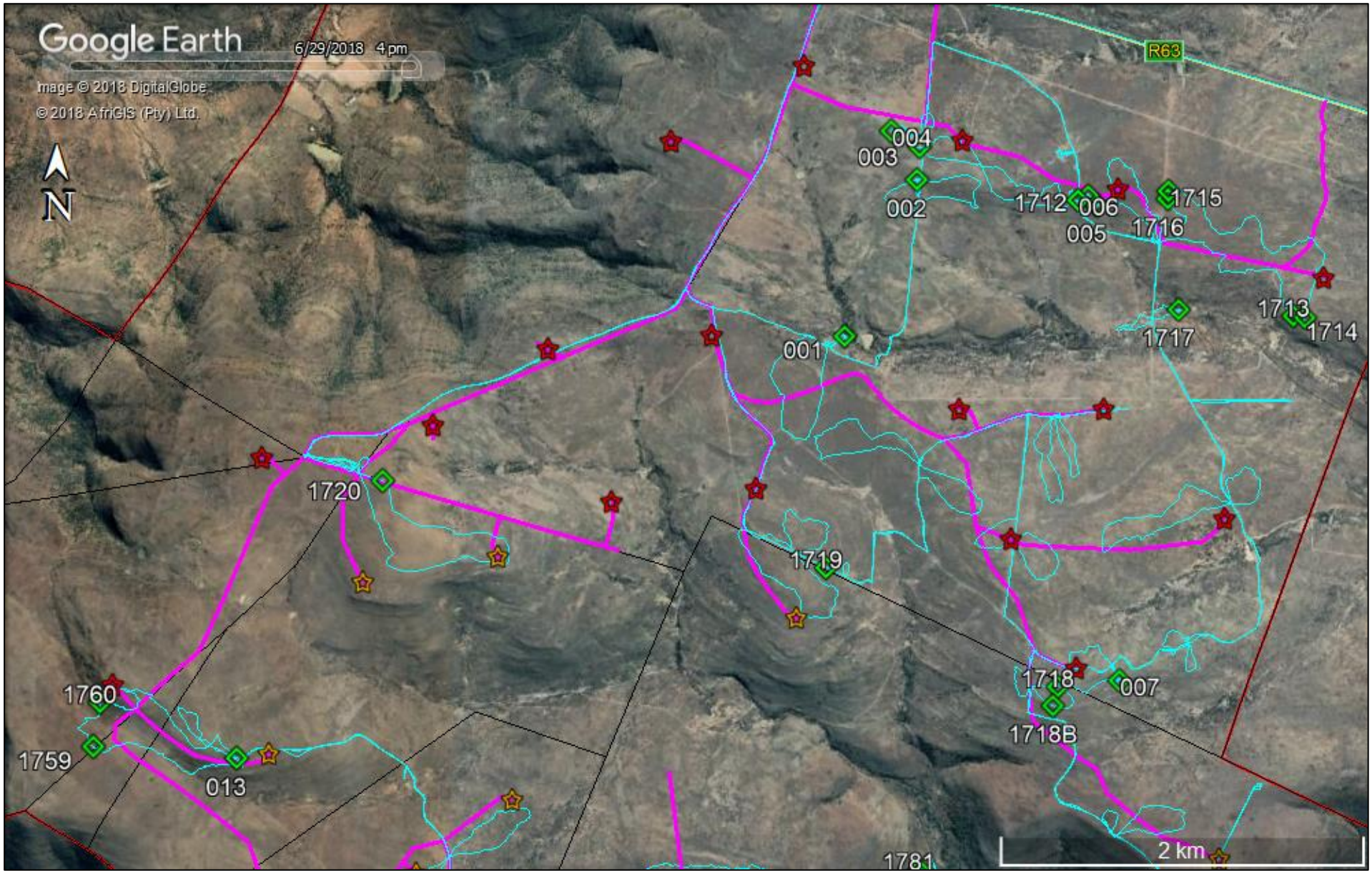
016	S32 44 04.4 E25 21 49.6	Elongated line of stones which would have been laid along the base of a fence in the past. The fence has since been removed.	Low
1794	S32 44 06.1 E25 21 53.3	Lower end of alignment.	
1797	S32 44 29.0 E25 22 14.9	The remains of a sluice gate which has been built in a swale cultivation area. Age unknown but certainly 20th century. Unlikely to be heritage per the NHRA.	---
1798	S32 44 08.4 E25 21 04.2	A large mound of stones placed over bedrock so definitely not a grave. Its function is unknown.	Low
1799	S32 48 05.5 E25 22 37.1	19th century cottage and an older stone ruin, both of which have had additions made to them. The cottage has a high degree of intactness, although is not in good condition.	High [AVOID] (individual points vary in significance from low to high but structures and especially graves are of higher significance)
1800	S32 48 03.5 E25 22 37.2	A circular trapvloer of *c.* 11-12 m diameter.	
1801	S32 48 02.2 E25 22 38.3	Nel family graveyard. Three graves as follows; H.J. Nel died 1929, A.M.E. Nel died 1929, and a stone-packed child's grave with no headstone. There is also a 'demolished' grave, possibly exhumed and removed to another location. The two Nels are together in a double grave. There are also some stones in one corner of the graveyard that seem like unused stones brought to the site for grave building.	
1802	S32 48 02.1 E25 22 37.1	Stone foundations and the remaining walls of two structures. There is also a small packed stone feature of unknown function just to the north.	
1803	S32 48 07.8 E25 22 34.2	Large stone kraal complex with walls collapsing in places. There are also corrugated iron roofs over parts of it.	
1804	S32 48 08.7 E25 22 32.8	Small stone cottage ruin with a low fenced enclosure in front of it. The ruin is far more intact than most stone ruins with just one collapsed section at the back, possibly where a window had been. There are many glass, ceramic and bone fragments between the kraal (waypoint 1803) and this cottage but not a defined dump.	
1805	S32 48 09.1 E25 22 33.4	A dispersed pile of stones of unknown function.	
1806	S32 48 09.7 E25 22 33.2	Several piles of stone, possibly collapsed walls but it is impossible to tell.	
1807	S32 48 19.6 E25 22 25.8	An east-facing Victorian farm house that has been extended towards the south and converted into a barn. The entire inside is stripped and the floor paved with flagstones, although one section retains its wooden floor. The façade retains its integrity but the inside is totally gone and the entire original roof has been removed and replaced.	Medium
1808	S32 48 19.3 E25 22 25.1	A stone shed with an old addition to its west side. A window in the south side has been filled in with stone. North, south and west ends have been whitewashed. A corrugated iron roof and flagstone floor have been added to the south side and a few old agricultural implements are housed there. The western addition contains what seems to be an original, wall-mounted wooden feeding trough.	Medium
1809	S32 48 21.6 E25 22 24.6	An unfenced informal graveyard with two double graves and three single graves. All are marked by tall stones with only minimal other stone.	High
1810	S32 48 37.1 E25 21 04.7	Stone line on the ground that indicates the position of an earlier fence.	Low

1811	S32 48 24.5 E25 22 35.1	A stone ruin with collapsed sections. It has been relatively recently used judging by the wooden poles, roof sheets, etc included here. There is a Belhambra tree close by to the east. There is lots of modern glass and ceramics in the general area.	Medium
1812	S32 48 24.5 E25 22 36.1	Brick cottage with steel windows and built on a stone plinth. Likely 1930s or 1940s in age. Has wooden floors inside but kitchen floor 9south end) is cement. Small addition to the rear contains an entrance way and a bathroom. Cottage seems to have been recently vacated.	Low-medium
1813	S32 48 26.1 E25 22 34.8	A stone feature that may be a collapsed structure of sorts. No foundation evident though.	Low.
1814	S32 48 41.2 E25 22 12.8 S32 48 40.3 E25 22 14.3	Historical quarry for building stone. The site is marked by a very tall upright stone so that it is visible from a distance as there are no other land marks. The two waypoints mark the ends of the site.	Low
1815	S32 48 38.2 E25 22 15.7	Remnants of some sort of stone feature.	Low
1816	S32 47 32.0 E25 22 48.3	An upright standing stone forming a beacon. Unknown function.	Low
1817	S32 47 19.8 E25 22 33.5	A sheep pen with stone-paved floors. Age uncertain.	Low
1818	S32 47 12.7 E25 22 17.6	Low density artefact scatter, probably of mixed age. Includes a small hornfels thumbnail scraper and a larger one in quartzite.	Low-medium
1819	S32 47 14.7 E25 22 36.7	An area of low density background scatter that includes a radial core.	Low
1820	S32 47 14.7 E25 22 39.4	An area of low density background scatter with ESA artefacts.	Low
1821	S32 47 13.4 E25 22 50.4	An area of low density background scatter with ESA and MSA artefacts. An MSA scraper on a convergent flake was noted nearby but away from the scatter.	Low
001	S32 42 23.0 E25 21 36.5	Weathered biface, flaked cobble and chunk in donga area.	Low
002	S32 41 55.8 E25 21 50.7	Selection of artefacts – flakes, chunk – on flat-lying area above donga. The raw material looked quite coarse so may not be hornfels.	Low
003	S32 41 50.1 E25 21 51.2	MSA point (quartzite? Or patinated hornfels?) and possible upper grindstone on slope.	Low
004	S32 41 47.5 E25 21 45.3	Weathered and patinated flakes, fresher blade fragment in same area as 003.	Low
005	S32 41 59.4 E25 22 28.6	Eastern extent of scatter of dispersed, weathered and patinated artefacts, including 2 small bifaces, MSA blade fragment, flakes and cores. All are probably made of hornfels.	Medium-Low
006	S32 41 58.6 E25 22 24.6	Western extent of the above scatter 005.	
007	S32 43 22.5 E25 22 34.8	Indeterminate stone structure made of dolerite blocks, approx. 2x2 m.	Low
013	S32 43 37.6 E25 19 32.7	Small scatter of artefacts on slope – large sandstone flake, hornfels artefacts including 2 LSA cores and flakes. Some are more weathered than others. A few more isolated artefacts higher up the slope.	Low
019	S32 44 32.7 E25 22 10.8	Large heap of dolerite boulders, approx. 3x5m. Seems too large to be a burial.	Low
020	S32 44 28.0 E25 21 06.7	Indeterminate heap of dolerite blocks, almost square, approx. 1x1m	Low
021	S32 44 32.9 E25 21 20.4	Scatter of dispersed artefacts, mainly fresh-looking hornfels flakes. Area approx. 15 to 20 m in E to W direction.	Low

APPENDIX 4 – Mapping

The series of aerial photographs that follow map the heritage finds in relation to the development. The various mapped items are as follows:

- Proposed wind turbines
    - Red stars – Highlands North Phase 1
    - Orange stars = Highlands Central Phase 2
    - Purple Stars = Highlands South Phase 3
- Proposed access roads (pink lines)
- Existing road proposed for upgrade and minor realignment in one section
- Heritage survey tracks (blue lines); and
- Heritage finds (numbered green symbols).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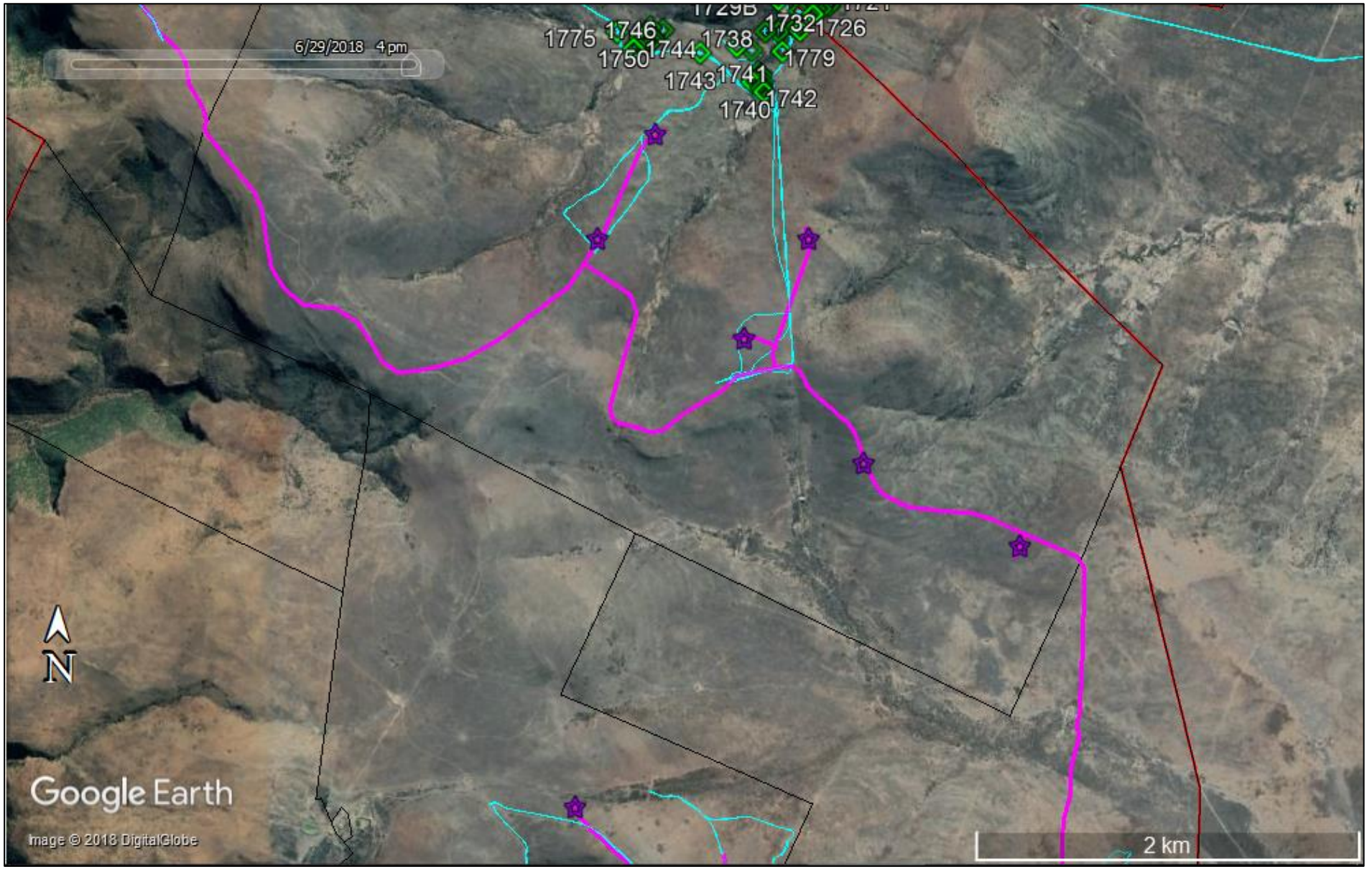
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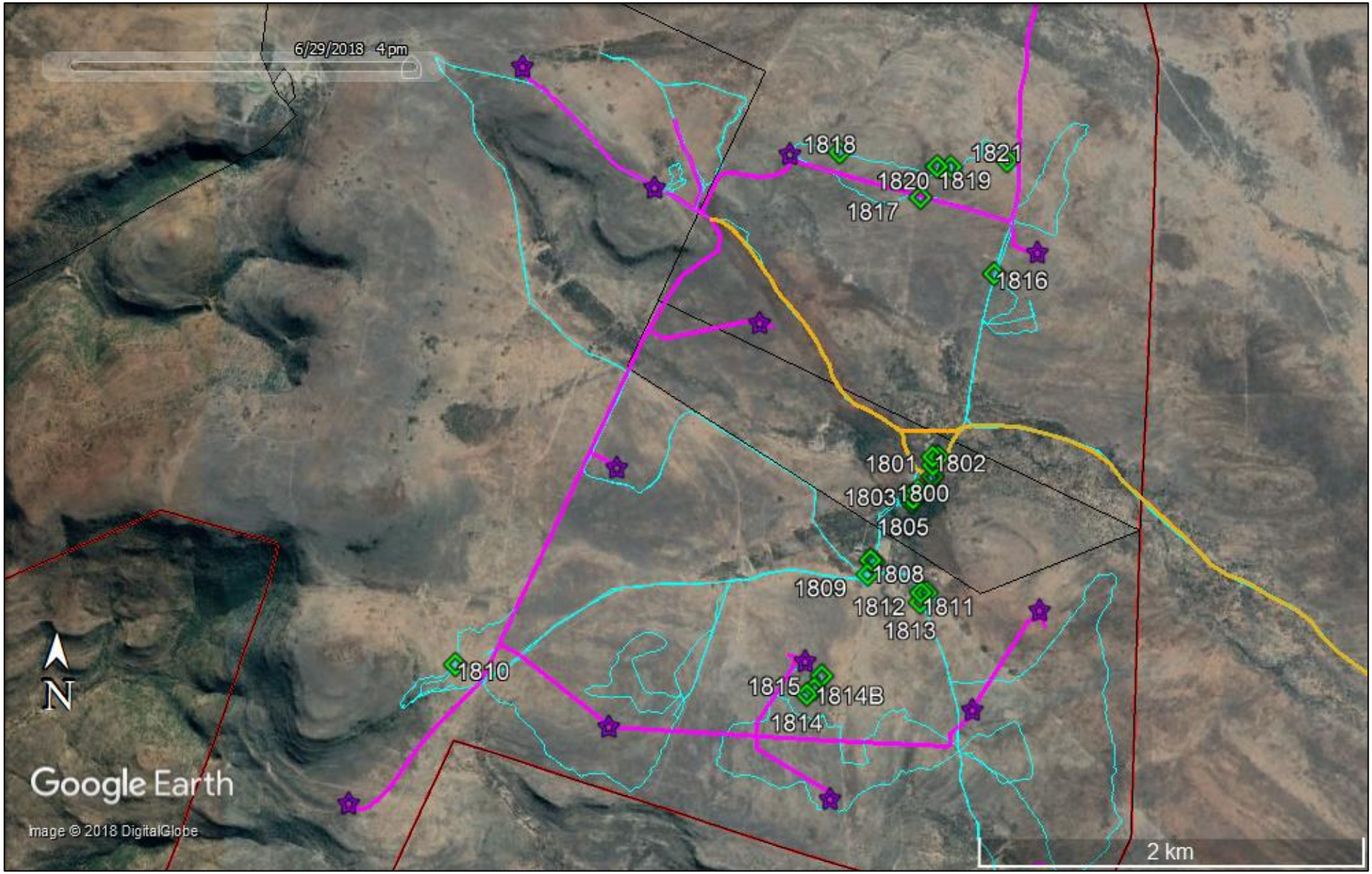
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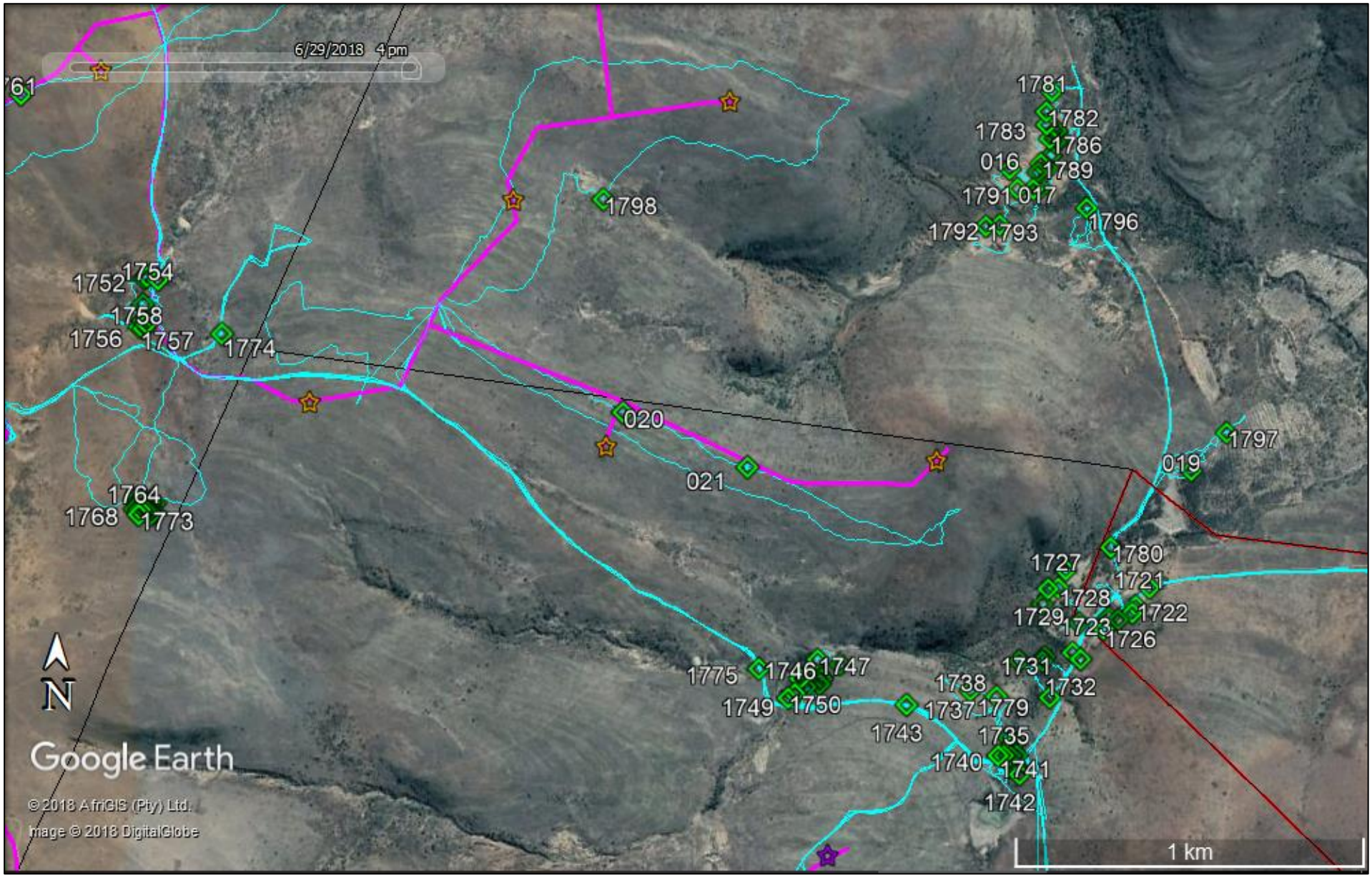
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APPENDIX 5 – Palaeontological specialist study

PALAEONTOLOGICAL HERITAGE: COMBINED DESKTOP & FIELD-BASED BASIC ASSESSMENT

Proposed Highlands Wind Energy Facility and associated Grid Connection, Somerset East District, Eastern Cape

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July 2018

EXECUTIVE SUMMARY

WKN Windcurrent South Africa (Ltd) Pty is proposing to develop a wind farm known as the Highlands Wind Energy Facility (WEF), together with associated infrastructure including an on-site connection to the National Grid, on a site located some 25 km to the west of Somerset East, Somerset East District, Eastern Cape. The proposed development site is situated within the gazetted Cookhouse REDZ (Renewable Energy Development Zone). For the purpose of obtaining Environmental Authorisation, the Highlands WEF project has been split into three phases: North, Central and South. Each WEF phase and each associated 66 kV or 132 kV grid connection are currently being subject to a Basic Assessment process. The palaeontological heritage assessment provided in this report applies to the Final Mitigated Layout of the Highlands WEFs and associated grid connections.

The Highlands WEF and grid connection project area near Somerset east is underlain at depth by potentially-fossiliferous fluvial sediments of the Karoo Supergroup (Adelaide Subgroup) assigned to the Late Permian Middleton and Balfour Formations of Late Permian age. Bedrock exposure levels here are very limited due to extensive cover by soils and coarse gravels as well as well-developed, semi-consolidated colluvial / alluvial deposits of the Pleistocene to Holocene Masotcheni Formation along major drainage lines. The Lower Beaufort Group sediments around Bruintjieshoogte are characterised by sparse fossil vertebrates (especially therapsids) of the Late Permian *Cistecephalus* Biozone, plants and petrified wood of the Gondwanan *Glossopteris* Flora, as well as rare tuffs (volcanic ashes) of importance for radiometric dating. However, during a five-day field study of the Highlands WEF project area the only fossil remains recorded comprised very rare therapsid skeletal remains (including two skulls and unidentified postcrania) within ferruginous carbonate concretions, several putative large (*c.* 15-30 cm wide) vertebrate burrows, rippled sandstone paleosurfaces associated with reedy plant stem casts and invertebrate burrows, and concentrations of sizeable (2 cm-wide) sphenophyte fern stem impressions (horsetails) – all from the Middleton Formation - but no petrified wood. It is concluded that the project area is largely of *low* palaeontological sensitivity. Significant impacts on thick, potentially-fossiliferous of the Masotcheni Formation along major stream valleys are not anticipated. No fossil material – such as bones and teeth of extinct mammals or reworked petrified wood – was recorded within these Pleistocene - Holocene colluvial / alluvial deposits.

Potential impacts to fossil heritage resources within the Highlands WEF and grid connection area involve the disturbance, damage or destruction of fossil material at or below the ground surface within the development footprint during the construction phase (*e.g.* for wind turbine footings, access roads). Due to the recorded, albeit sparse, occurrence of rare vertebrate fossils (skeletal remains and burrows) of scientific importance within the WEF project area, potential impacts on palaeontological heritage during the construction phase of the Highlands North WEF, Highlands Central WEF and Highlands South WEF are assessed as of *medium* (*negative*) significance without mitigation, falling to *low* (*negative*) significance if the proposed mitigation measures are fully implemented. The No-go alternative (*i.e.* no WEF) would have a neutral impact on palaeontological heritage. There is no preference on palaeontological grounds for one or other of the Substation C1 or C2 sites under consideration.

The impact significance of all grid connection route alternatives under consideration is rated as low (negative), before and after mitigation, given (1) the small scale of excavations for the powerline pylon footings, (2) the shortness of the lines, as well as (3) the low density of sensitive fossil sites recorded within the various grid connection corridors under consideration. The only exception is the Highlands North WEF grid connection Alternative 2 where several vertebrate fossils are recorded within a small area inside the powerline corridor (small yellow area on farm Rietfontein 102 outlined in Fig. 51). Here impact significance is assessed as medium (negative) before mitigation falling to low (negative) after mitigation. Mitigation through site avoidance (*i.e.* no disturbance or new infrastructure either side of existing farm track here) or, failing that, pre-construction collection and recording of fossils by a professional palaeontologist is acceptable here. In the case of the Highlands Central WEF and Highlands South WEF there is no preference on palaeontological grounds for one or other route alignment, while for Highlands North WEF the Alternative 1 route alternative is preferred.

Cumulative impacts posed by the three Highlands WEF projects and their associated grid connections, individually and collectively, are inferred to be *low* in the context of several other approved or proposed WEF developments assessed in the broader Somerset East – Cookhouse – Middleton region. Given the poor bedrock exposure levels and lack of intensive palaeontological research in the region, confidence levels for this impact assessment are *medium*.

Pending the potential discovery of significant new fossil remains (*e.g.* vertebrate bones and teeth, burrows, trackways, plant fossils including petrified wood) during the construction phase of the Highlands WEF and grid connection, no further specialist palaeontological studies or mitigation are recommended for this project in the construction phase. There are no fatal flaws to the proposed wind farm project as far as fossil heritage is concerned. Providing that the Chance Fossil Finds Procedure outlined below and tabulated in Appendix 1 is followed through, there are no objections on palaeontological heritage grounds to authorisation of the Highlands North WEF, Highlands Central WEF and Highlands South WEF and their associated grid connections.

The suitably qualified and experienced Environmental Control Officer (ECO) responsible for the wind farm development construction phase should be made aware of the potential occurrence of scientifically-important fossil remains within the development footprint. During the construction phase all major clearance operations (*e.g.* for new access roads, turbine

placements) and deeper (> 1 m) excavations should be monitored for fossil remains on an on-going basis by the ECO. Should substantial fossil remains be encountered at surface or exposed during construction, the ECO should safeguard these, preferably *in situ*. They should then alert the Eastern Cape Provincial Heritage Resources Agency, ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; smokhanya@ecphra.org.za) as soon as possible. This is to ensure that appropriate action (*i.e.* recording, sampling or collection of fossils, recording of relevant geological data) can be taken by a professional palaeontologist at the proponent's expense. These recommendations are summarized in the tabulated Chance Fossil Finds Procedure appended to this report (Appendix 2).

The palaeontologist concerned with any mitigation work will need a valid fossil collection permit from ECPHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies developed by SAHRA (2013).

These monitoring and mitigation recommendations are to be incorporated into the Environmental Management Programme (EMPr) for the Highlands WEF developments, including the associated grid connections. The operational and decommissioning phases of this development are unlikely to have further significant impacts on palaeontological heritage and no additional recommendations are made in this regard (The Chance Fossil Finds Procedure tabulated in Appendix 2 still applies).

Summary significance table: palaeontological heritage impacts (construction phase)

Project		Impact significance		Recommended mitigation	
		Before mitigation	After mitigation		
Highlands N WEF		MEDIUM	LOW	No specialist mitigation	Apply Chance Fossil Finds Procedure (Appendix 2)
Highlands N grid connection	**Alt.1**	LOW	LOW	No specialist mitigation	
	Alt.2	MEDIUM	LOW	Avoid[1] or professionally mitigate documented vertebrate fossil sites within corridor	
Highlands C WEF		MEDIUM	LOW	No specialist mitigation	
Highlands C grid connection	**Alt.1**	LOW	LOW	No specialist mitigation	
	Alt.2	LOW	LOW	No specialist mitigation	
Highlands S WEF		MEDIUM	LOW	No specialist mitigation	
Highlands C grid connection	**Alt.1**	LOW	LOW	No specialist mitigation	
	Alt.2	LOW	LOW	No specialist mitigation	

1. *i.e.* no disturbance of new infrastructure either side of existing farm road close to fossil sites.

1. INTRODUCTION

The company WKN Windcurrent South Africa (Ltd) Pty is proposing to develop a wind farm known as the Highlands Wind Energy Facility (WEF), together with associated infrastructure including an on-site connection to the National Grid, on a site located some 25 km to the

west of Somerset East, Somerset East District, Eastern Cape (Fig. 1). The proposed development site is situated within the gazetted Cookhouse REDZ (Renewable Energy Development Zone). The affected land parcels – situated in hilly terrain south of the R63 tar road (Figs. 2 & 3) – are currently zoned for agriculture and cover an area of approximately 11 180 hectares in total of which *c*. 9000 ha are of interest for WEF development.

The Highlands WEF project area is underlain by potentially fossiliferous rocks of Palaeozoic to Recent age, notably the Permian Lower Beaufort Group (Karoo Supergroup) and the Pleistocene Masotcheni Formation, with several fossil sites recorded in the region. Most of the area is accordingly identified as potentially Highly Sensitive from a palaeontological perspective (SAHRIS Website). The present palaeontological specialist report contributes to the comprehensive Basic Assessment for the Highlands WEF alternative project that is being co-ordinated by Arcus Consulting, Cape Town (Contact details: Ms Anja Albertyn. Arcus. Office 220 Cube Workspace, Cnr Long Street and Hans Strijdom Road, Cape Town, 8001, RSA. Tel: +27 (0) 21 412 1533 / +27 (0) 76 265 8933. E-mail: anjaa@arcusconsulting.co.za).

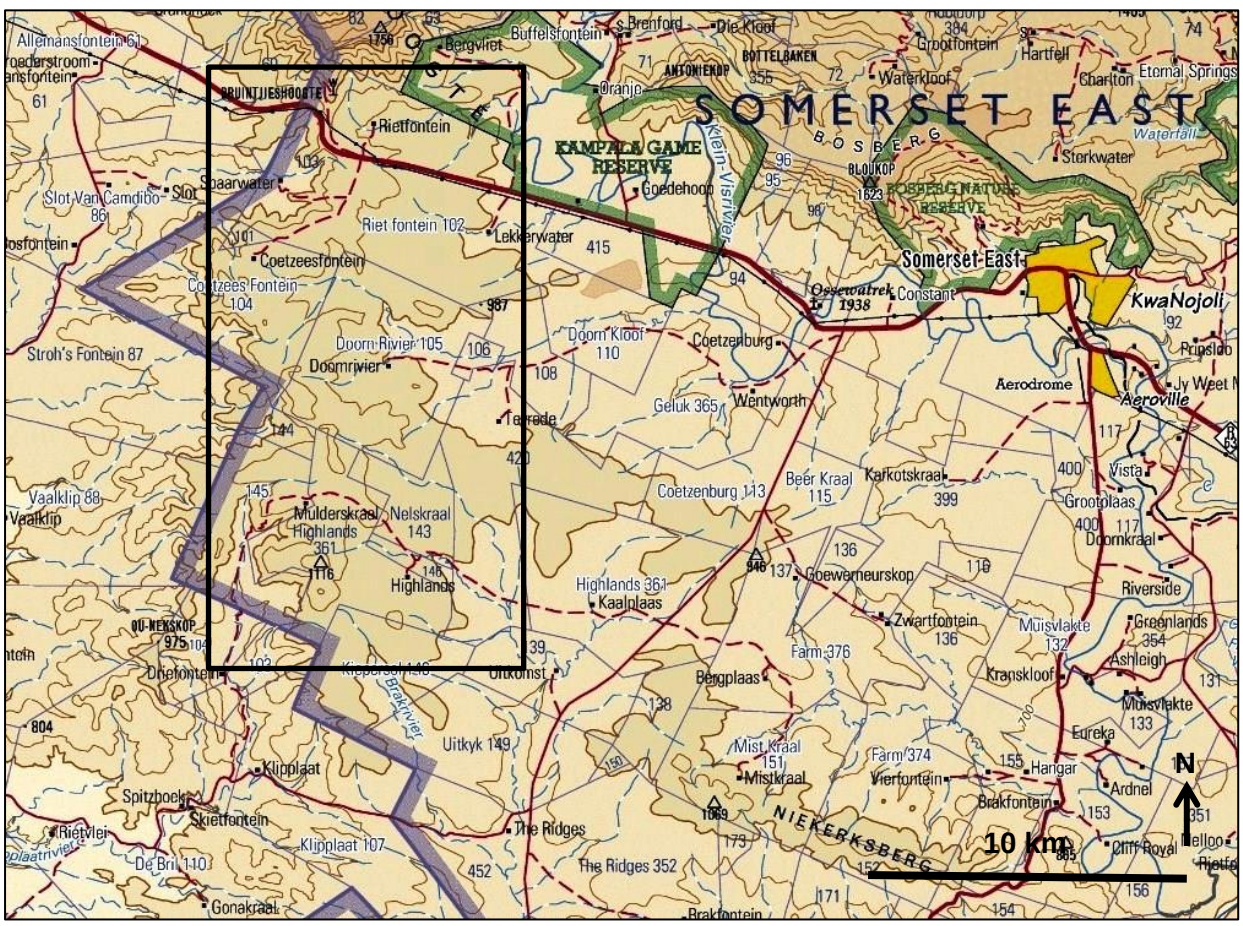

Figure 1. Extract from 1: 250 000 topographical sheet 3224 Graaff-Reinet (Courtesy of the Chief Directorate: National Geospatial Information, Mowbray) showing the *approximate* location of the Highlands WEF study area situated at the foot of the Great Escarpment (Groot-Bruintjieshoogte Mountains) and south of the R63, *c.* 25 km west of Somerset East, Somerset East District, Eastern Cape (black rectangle).

Property Owner	Farm Portion	Size	SG Number
ZIRK JORDAAN FAMILY TRUST	Farm 102 Rietfontein Farm 102 – Portion 0 Remaining Extent	2443.50	C06600000000010200000
SA Government (Tenant: Simphewe & Linda Fani)	Farm 104 Coetzees Fontein Farm 104 - Portion 0	25.54	C06600000000010400000
	Farm 104 Coetzees Fontein Farm 104 - Portion 1	389.41	C06600000000010400001
	Farm 104 Coetzees Fontein Farm 104 - Portion 2	618.43	C06600000000010400002
	Farm 105 Doorn Rivier Farm 105 - Portion 0 Remaining Extent	1284.80	C06600000000010500000
	Farm 105 Doorn Rivier Farm 105 - Portion 1	1027.83	C06600000000010500001
	Farm 143 Nels Kraal Farm 143 – Portion 0	689.13	C06600000000014300000
	Farm 146 Kiepersol Farm 146 – Portion 1	125.91	C06600000000014600001
SA Government (Tenant: Tozi Nelani)	Farm 144 Nelskom Farm 144 - Portion 0 Remaining Extent	223.91	C06600000000014400000
	Farm 145 De Mullers Kraal Farm 145 – Portion 0	865.33	C06600000000014500000
	Farm 145 De Mullers Kraal Farm 145 – Portion 8	0.88	C06600000000014500008
HIGHLANDS TRUST	Farm 361 Highlands Farm 361 – Portion 0 Remaining Extent	1828.82	C06600000000036100000
G K W GEBOU TRUST	Farm 103 Spaarwater Farm 103 – Portion 0	854.39	C06600000000010300000
Jakkie Nel Trust	Farm 101 Lekker water Farm 101 – Portion 2	53.96	C06600000000010100002
	Farm 104 Coetzees Fontein Farm 104 – Portion 5	650.37	C06600000000010400005

Figure 2. Table showing the constituent land parcels forming the Highlands WEF and grid connection study area (Table provided by Arcus Consulting).

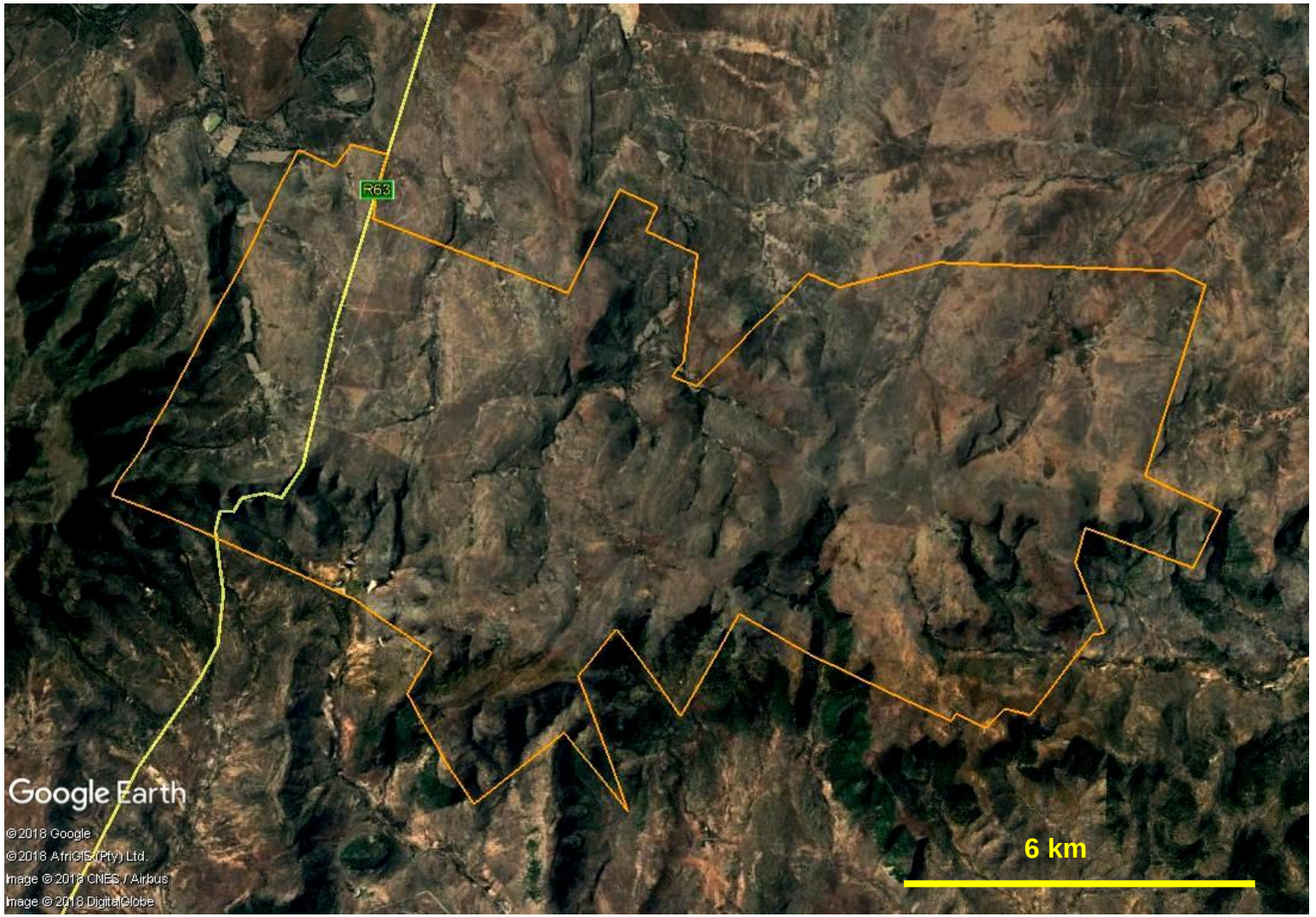

Figure 3. Google Earth© satellite image of the Highlands WEF study area showing the upland rolling hilly terrain – located to the south of the Great Escarpment and east of the lower escarpment facing west onto the Camdeboo region – where the WEF infrastructure will be sited. *N.B.* N is towards the LHS of the image. Scale bar = 6 km.

1.2. Project outline

For the purpose of obtaining Environmental Authorisation, the Highlands WEF project has been split into three phases: North, Central and South. The following *six* components of the proposed alternative energy development, representing *three* development phases, are being assessed as part of the BA process:

- **Phase 1 (north):**

1. Highlands North WEF

The proposed Highlands North WEF will comprise 17 turbines with a maximum generation capacity of 5 MW *per* turbine. Internal roads will connect the turbines. On-site cabling will largely follow the road infrastructure where possible and will be either overhead or underground. One on-site substation location (Substation A) will form part of this application.

2. Electrical Grid Connection and Associated Infrastructure for Highlands North WEF

The proposed 66 kV or 132 kV Grid Connection will connect Substation A to the Eskom transmission line. Two route alternatives are proposed. The maximum length will be 5 km with a 31 m-wide servitude. A 300 m corridor surrounding the proposed line is being assessed (150 m each side).

- **Phase 2 (central):**

3. Highlands Central WEF

The proposed Highlands Central WEF will comprise 14 wind turbines with each turbine having an installed maximum generation capacity of 5 MW *per* turbine. Internal roads will connect the turbines. On-site cabling will largely follow the road infrastructure where possible and will be either overhead or underground. One on-site substation location (Substation B) will form part of this application. An existing access road may require upgrading as part of this application.

4. Electrical Grid Connection and Associated Infrastructure for Highlands Central WEF

The proposed 132 kV Grid Connection will connect Substation B to the Eskom transmission line. Two route alternatives are proposed. The maximum length will be 8 km with a 31 m-wide servitude. A 300 m corridor surrounding the proposed line alternatives is being assessed (150 m each side).

- **Phase 3 (south):**

5. Highlands South WEF

The proposed Highlands South WEF will comprise 18 wind turbines with each turbine having an installed maximum generation capacity of 5 MW *per* turbine. Internal roads will connect the turbines. On-site cabling will largely follow the road infrastructure where possible and will be either overhead or underground. Two on-site substation locations (Substation C1 and C2) will form part of this application. An existing access road may require upgrading as part of this application.

6. Electrical Grid Connection and Associated Infrastructure for Highlands South WEF Phase 3:

The proposed 66 kV and /or 132 kV Grid Connection will connect Substation C1 and C2 to the Eskom transmission line. Two route alternatives are proposed. The maximum length of the line will be 20 km with a 31 m-wide servitude. A 300 m corridor surrounding the proposed line alternatives is being assessed (150 m each side).

If the projects are successful in obtaining Environmental Authorisation the Highlands Central WEF (Phase 2) will be combined with either Highlands North (Phase 1) or Highlands South (Phase 3), depending on meteorological data. A maximum of two substation locations will be used to connect the two windfarms to the two Eskom transmission line tie-ins.

A combined provisional layout of all six components of the WEF including the various grid connection options is shown in Figures 51 to 53. It is noted that the combined footprint of the six development components will only occupy a very small portion (approximately 2%) of the land within the project area outlined in Figure 3. The turbine locations shown have been chosen from numerous site options following a multi-disciplinary screening process (*i.e.* they are already partially mitigated); alternative layouts are therefore not being assessed here.

1.2. Terms of Reference

The Terms of Reference for the present specialist palaeontological heritage report, as defined by Arcus Consulting, is the compilation of a single Basic Assessment report for the proposed Highlands WEF development that consists of six applications (3 WEF and 3 Grid applications), as *per* supplied kmz and project description, with a combined baseline and six separate assessment chapters. The report should satisfy the requirements of the national Environmental Management (NEMA) Act (Act 107 of 1988) and the 2017 Amended Environmental Impact Assessment Regulations of 2017 (GNR 326, Appendix 6) (See Table 1).

Table 1.1. Index to components of this palaeontological specialist report

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	**13**
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	**14**
(c) an indication of the scope of, and the purpose for which, the report was prepared;	**1.2**
(cA) an indication of the quality and age of base data used for the specialist report;	**2**
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	**7**
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**2**
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	**2**
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	**7**
(g) an identification of any areas to be avoided, including buffers;	**8**
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	**Figs. 51-53**
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	**3**
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment, or activities;	**5-7**
(k) any mitigation measures for inclusion in the EMPr;	**8**
(l) any conditions for inclusion in the environmental authorisation;	**8**
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	**8**
(n) a reasoned opinion— i. as to whether the proposed activity, activities or portions thereof should be authorised; iA. Regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan;	**9**
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**n/a**
(p) any other information requested by the competent authority	**n/a**
Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	

2. STUDY APPROACH & SOURCES

This combined desktop and field-based palaeontological Basic Assessment report provides an assessment of the observed or inferred palaeontological heritage within the Highlands WEF and associated powerline project area, with recommendations for specialist palaeontological mitigation where this is considered necessary. The report is based on (1) a review of the relevant scientific literature, including previous palaeontological impact assessments in the area (*e.g.* Amakhala Emoyeni WEF (De Klerk 2010), Cookhouse WEF (Almond 2009, 2010b, Durand 2010), Middleton WEF (Almond 2011, 2013c), Spitskop WEF (Almond 2013a), Nojoli WEF (Almond 2014) and Nxuba WEF (Almond 2015)), (2) published topographical and geological maps and accompanying sheet explanations (1: 250 000 Sheet 3224 Graaff-Reinet; Hill 1993) as well as Google Earth© satellite imagery, (3) a five-day field study of the consolidated Highlands study area (6-11 February, 2018) *plus* a preceding short palaeontological heritage screening report (Almond 2017), as well as (4) the author's extensive field experience with the formations concerned and their palaeontological heritage (Almond *et al.* 2008).

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations, *etc.*) represented within the study area are determined from geological maps and satellite images. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author's field experience (consultation with professional colleagues as well as examination of institutional fossil collections may play a role here, or later following scoping during the compilation of the final report). This data is then used to assess the palaeontological sensitivity of each rock unit to development (provisional tabulations of palaeontological sensitivity of all formations in the Eastern Cape have already been compiled by J. Almond and colleagues; *e.g.* Almond *et al.* 2008) and are shown on the palaeosensitivity map on the SAHRIS (South African Heritage Resources Information System) website. The likely impact of the proposed development on local fossil heritage is then determined on the basis of (1) the palaeontological sensitivity of the rock units concerned and (2) the nature and scale of the development itself, most notably the extent of fresh bedrock excavation and ground clearance envisaged. When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a field assessment study by a professional palaeontologist is usually warranted.

The focus of palaeontological field assessment is *not* simply to survey the development footprint or even the development area as a whole (*e.g.* farms or other parcels of land concerned in the development). Rather, the palaeontologist seeks to assess or predict the diversity, density and distribution of fossils within and beneath the study area, as well as their heritage or scientific interest. This is primarily achieved through a careful field examination of one or more representative exposures of all the sedimentary rock units present (*N.B.* Metamorphic and igneous rocks rarely contain fossils). The best rock exposures are generally those that are easily accessible, extensive, fresh (*i.e.* unweathered) and include a large fraction of the stratigraphic unit concerned (*e.g.* formation). These exposures may be natural or artificial and include, for example, rocky outcrops in stream or river banks, cliffs, quarries, dams, dongas, open building excavations or road and railway cuttings. Uncemented superficial deposits, such as alluvium, scree or wind-blown sands, may occasionally contain fossils and should also be included in the field study where they are well-represented in the study area. It is normal practice for impact palaeontologists to collect representative, well-localised (*e.g.* GPS and stratigraphic data) samples of fossil material during field assessment studies. In order to do so, a fossil collection permit from SAHRA is required and all fossil material collected must be properly curated within an approved repository (usually a museum or university collection).

Note that while fossil localities recorded during field work within the study area itself are obviously highly relevant, most fossil heritage here is embedded within rocks beneath the land surface or obscured by surface deposits (soil, alluvium, *etc.*) and by vegetation cover. In many cases where levels of fresh (*i.e.* unweathered) bedrock exposure are low, the hidden fossil resources have to be *inferred* from palaeontological observations made from better exposures of the same formations elsewhere in the region but outside the immediate study area. Therefore a palaeontologist might reasonably spend far *more* time examining road cuts and borrow pits close to, but outside, the study area than within the study area itself. Field data from localities even further afield (*e.g.* an adjacent province) may also be adduced to build up a realistic picture of the likely fossil heritage within the study area.

On the basis of the desktop and field studies, the likely impact of the proposed development on local fossil heritage and any need for specialist mitigation are then determined. Adverse palaeontological impacts normally occur during the construction rather than the operational or decommissioning phase. Mitigation by a professional palaeontologist – normally involving the recording and sampling of fossil material and associated geological information (*e.g.* sedimentological and taphonomic data) – is usually most effective during the preconstruction phase or, in some cases in the construction phase when fresh fossiliferous bedrock has already been exposed by excavations. To carry out mitigation, the palaeontologist involved will need to apply for a palaeontological collection permit from the relevant heritage management authority, the Eastern Cape Provincial Heritage Resources Agency, ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; smokhanya@ecphra.org.za). It should be emphasised that, *providing appropriate mitigation is carried out*, the majority of developments involving bedrock excavation can make a *positive* contribution to our understanding of local palaeontological heritage.

3. ASSUMPTIONS AND LIMITATIONS

The accuracy and reliability of palaeontological specialist studies as components of heritage impact assessments are generally limited by the following constraints:

1. Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant (“mappable”) bedrock units as well as major areas of superficial “drift” deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil *etc*), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.

3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information.

4. The extensive relevant palaeontological “grey literature” - in the form of unpublished university theses, impact studies and other reports (*e.g*. of commercial mining companies) - that is not readily available for desktop studies.

5. Absence of a comprehensive computerised database of fossil collections in major RSA institutions which can be consulted for impact studies.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:

a) *underestimation* of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or

b) *overestimation* of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous “drift” (soil, alluvium *etc*).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails *inferring* the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist, as in the case of the present study.

In the case of the Highlands WEF project area bedrock exposure is highly constrained by extensive superficial deposits, especially in areas of low relief, as well as by grassy vegetation. The study area is very extensive and for the most part topographically subdued, with gentle hillslopes and few access roads. However, sufficient bedrock exposures were examined during the course of the five-day field study to assess the palaeontological heritage sensitivity of the main rock units represented within the study area (See geological and palaeontological data table in Appendix 1). Away from the Great Escarpment and the R63, comparatively few academic palaeontological studies have been carried out hitherto in the region, so any new data from impact studies here are of scientific interest. Palaeontological and geological data from the recent field study is usefully supplemented by those from several other field-based fossil heritage impact studies carried out in the Somerset East – Cookhouse – Bedford – Middleton region by the author and other palaeontologists in recent years (See reference list). Confidence levels for this impact assessment are consequently rated as *medium*, despite the unavoidable constraints of limited exposure, time and access.

4. LEGISLATIVE CONTEXT

The present combined desktop and field-based palaeontological heritage report falls under Sections 35 and 38 (Heritage Resources Management) of the South African Heritage Resources Act (Act No. 25 of 1999), and it will also inform the EMPr for this project.

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

- geological sites of scientific or cultural importance;

- palaeontological sites;
- palaeontological objects and material, meteorites and rare geological specimens.

According to Section 35 of the National Heritage Resources Act, dealing with archaeology, palaeontology and meteorites:

(1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.

(2) All archaeological objects, palaeontological material and meteorites are the property of the State.

(3) 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.

(4) No person may, without a permit issued by the responsible heritage resources authority—

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) 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

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—

(a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;

(b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;

(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph *(a)* to apply for a permit as required in subsection (4); and

(d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have been published by SAHRA (2013).

5. GEOLOGICAL CONTEXT

The combined project area for the Highlands Central and North WEFs is situated at the foot of the Great Escarpment - here represented by the Groot-Bruintjieshoogte Mountains, reaching 1755 m amsl). It lies some 25 km west of Somerset East and a similar distance SE of Pearston, spanning the boundary between these two districts of the Eastern Cape. The area mainly comprises elevated hilly terrain up to *c*. 1000 m amsl situated to the south of the R63 along the watershed between westward-draining tributaries of the Voëlrivier and eastward-draining tributaries of the Kleinvisrivier. The historically important Bruintjieshoogte Pass along the modern R63 tar road crosses a narrow *nek* at the base of the Great Escarpment in the northern portion of the area (Palmer 1966). It features extensive, geologically-informative cuttings through the Karoo bedrocks that are also of geoheritage significance because of the datable volcanic ash horizon recorded here (Rubidge *et al.* 2013) (Figs. 11 & 12). Elsewhere potentially fossiliferous bedrock exposures are largely largely confined to drainage lines, erosion gullies (*dongas*), steeper hillslopes (notably along the dissected lower escarpment in the western portion of the area as well as the Bruintjieshoogteberge slopes north of the R63), farm dams, road cuttings and quarries or borrow pits (Figs. 6 to 10).

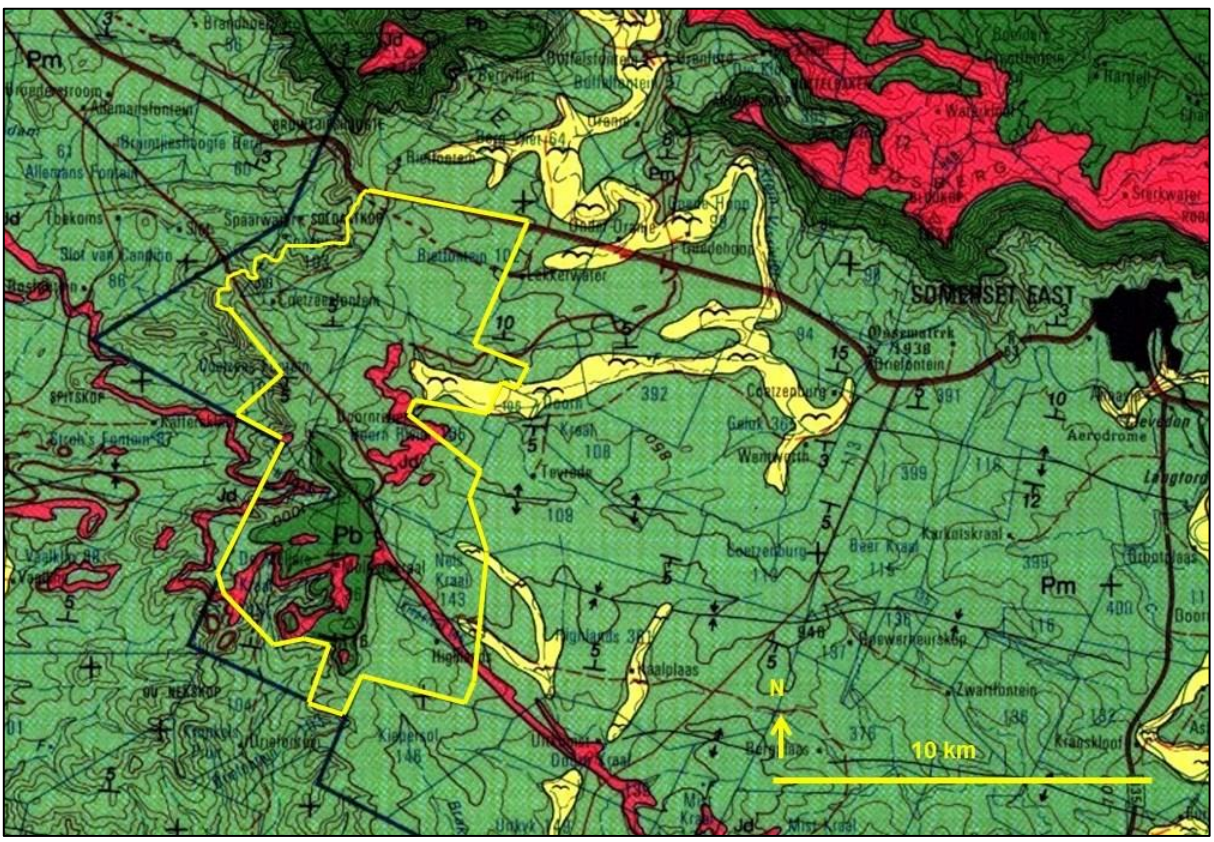

Figure 4. Extract from 1: 250 000 geology map 3224 Graaff-Reinet showing the outline of the combined Highlands WEF project area (yellow polygon) situated at the foot of the Groot-Bruintjieskloof escarpment between Somerset East and Pearston, Eastern Cape. The study area is underlain by Late Permian continental sediments of the Middleton Formation (Pm, pale green) and the overlying Balfour Formation (Pb, dark green) of the Adelaide Subgroup (Lower Beaufort Group). The narrow pink areas indicate unfossiliferous Karoo dolerite intrusions (sills, dykes) of Late Jurassic age. Late Caenozoic alluvial sediments (pale yellow) are mapped along the larger major tributaries of the Kleinvisrivier and other important drainage lines (pale yellow). Numerous smaller, but still substantial, bodies of semi-consolidated Late Caenozoic gravelly to sandy alluvial and colluvial deposits – here referred provisionally to the Pleistocene – Holocene Mosotcheni Formation – occur along minor drainage lines within the WEF project area but are not mapped at this scale.

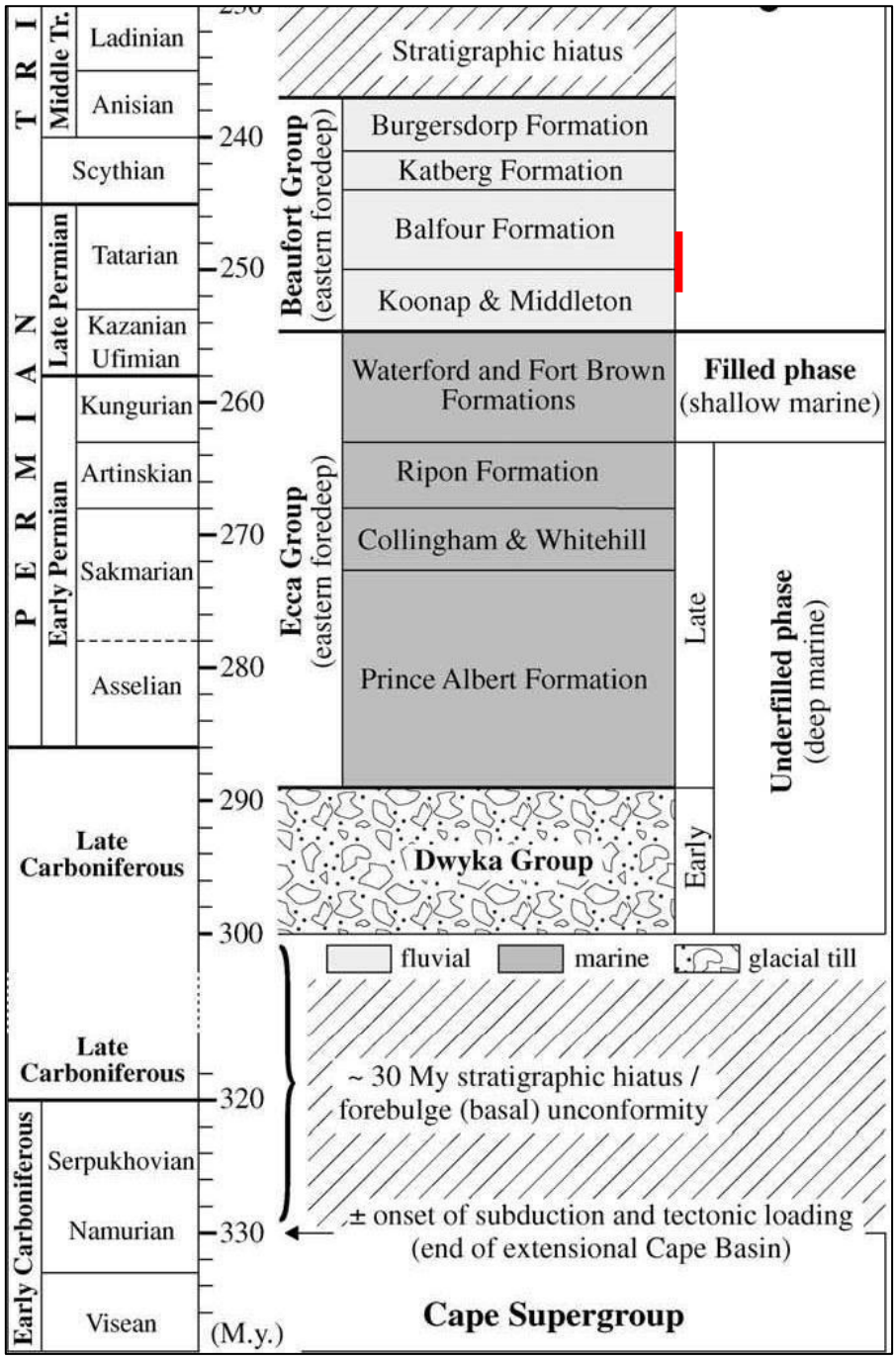

Figure 5. Stratigraphic subdivision of the Carboniferous and Permian portions of the Karoo Supergroup in the Main Karoo Basin (From Catuneanu *et al.* 2005). The Late Permian upper Middleton and lower Balfour Formations within the Lower Beaufort Group (Adelaide Subgroup) that are represented within the Highlands project area are emphasized by the thick red bar.

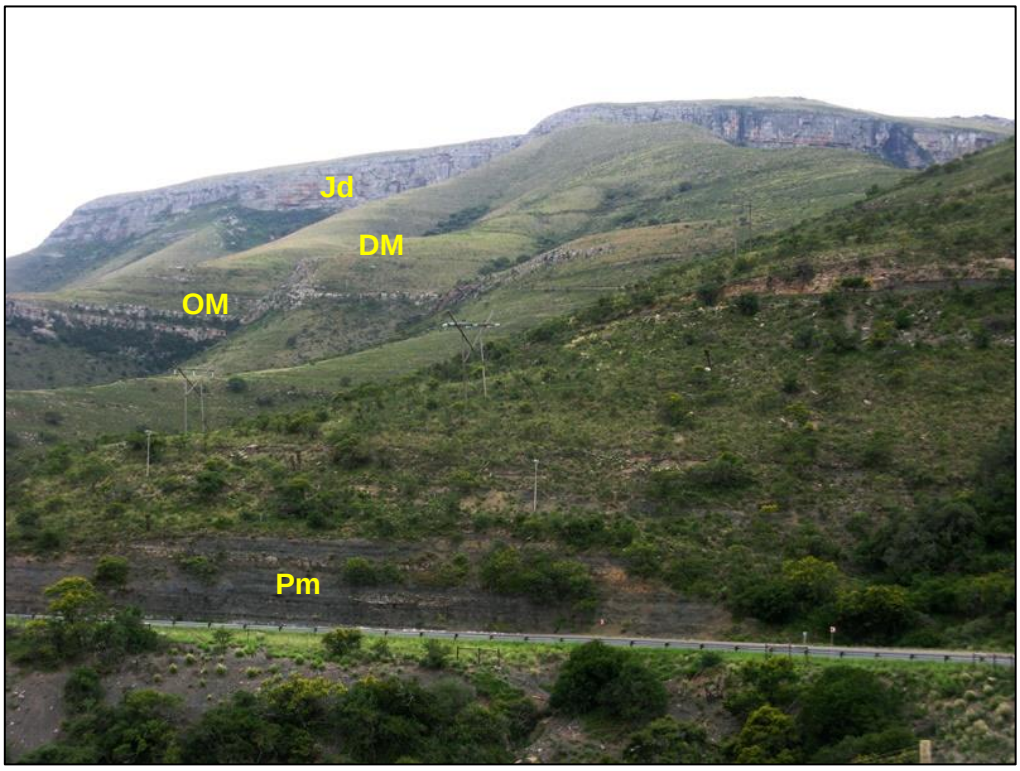

Figure 6. Lower Beaufort Group lithostratigraphy in the Groot-Bruintjieshoogte Mountains on the N side of the Highlands WEF project area. The mudrock-dominated Middleton Formation (Pm) exposed along the R63 Bruintjieshoogte Pass (Loc. 229) is overlain by the basal sandstone package of the Balfour Formation (Oudeberg Member, OM) and the mudrock-rich Daggaboersnek Member (DM). The cliff along the skyline is formed by a major dolerite sill (Jd) as well as adjacent baked Balfour Formation country rocks.

Figure 7. View southwards from the R63 at Bruintjieshoogte Pass (Loc. 229) showing the west-facing escarpment along the western edge of the Highlands WEF project area. The Middleton Formation here is mainly composed of overbank mudrocks with intermittent thin, prominent-weathering channel sandstones.

Figure 8. Typical rolling grassy terrain in the northern and central sectors of the Highlands project area (Loc. 250) with very limited bedrock exposure and gullied exposure of pale Masotcheni Formation alluvial sands along larger drainage lines (middle ground).

Figure 9. Dark grey Lower Beaufort Group bedrocks (Middleton Formation) exposed along larger stream and river courses – here a tributary of the Doornrivier - where they are sharply overlain by semi-consolidated alluvium of the Masotcheni Formation and younger soils (Loc. 244).

Figure 10. View across the southern portion of the Highlands WEF project area, looking south, with baked Balfour Formation sandstones on the foreground and a higher-lying plateau in the background underlain by a major Karoo Dolerite sill (Loc. 307).

5.1. Lower Beaufort Group

The WEF project area is largely underlain by Permian continental sediments of the **Lower Beaufort Group** (Adelaide Subgroup, Karoo Supergroup). These sediments are assigned to the **Middleton** and **Balfour Formations** of Late Permian age (pale and dark green areas in Fig. 4) (See also stratigraphic column in Fig. 5).

5.1.1. Middleton Formation

This formation forms the middle portion of the Adelaide Subgroup east of 24°E, including the Graaff-Reinet sheet area (Hill 1993, Johnson *et al*., 2006). The fluvial Middleton succession comprises greenish-grey to reddish overbank mudrocks with subordinate resistant-weathering, fine-grained channel sandstones deposited by large meandering river systems. Because of the dominance of recessive-weathering mudrocks, the Middleton Formation erodes readily to form low-relief hilly terrain at the base of the Escarpment near Bruintjieshoogte and extensive exposures of fresh (unweathered) bedrock are comparatively rare.

The sedimentology of the meandering fluvial Middleton Formation succession has been outlined by Hill (1993) as well as Catuneanu and Bowker (2001) and is described for the Cookhouse - Middleton area by Almond (2010b, 2013b, 2013c, 2014). The Lower Beaufort succession here is dominated by blue-grey to greenish-grey, hackly-weathering mudrocks. These are mainly silty but also muddy, variously massive (unbedded) to well-bedded, often showing clearly developed fining-upwards and thinning-upward cycles within the succession. Olive-grey, maroon to purple-brown and mottled maroon / grey mudrocks occur less frequently but are not uncommon. Arid climate palaeosol horizons characterised by abundant rusty to cream-coloured calcrete are variously rare

to fairly common within different parts of the overbank mudrock succession and are an important focus for palaeontological fieldwork since vertebrate fossils are often concentrated at these levels. Rare stellate pseudomorphs after gypsum ("desert roses") also point towards at least seasonally arid Late Permian palaeoclimates in the eastern Main Karoo Basin during some Late Permian time intervals.

Middleton Formation sandstones include thin crevasse-splay bodies with a tabular geometry as well as thicker, tabular to lenticular channel sandstones, variously single- to multi-storey, massive or with internal cross-bedding. The channel sandstones are generally fine- to medium-grained, buff coloured, with conformable to erosive bases. However, well-developed basal channel breccio-conglomerates with reworked mudflakes and calcrete nodules are not generally seen. Contacts between finer-grained sandstones and overbank mudrocks are often obscure (especially where the rocks are baked) and may be loaded, suggesting soupy, waterlogged floodplain conditions (Fig. 20). Large megaripples, undulose channel bar surfaces and prograding point bar sands are seen locally. These surfaces are often associated with features such as small-scale wave ripples, algal mat textured surfaces, adhesion warts, narrow horizontal burrows (possibly mat-grazers), fine mudcracks, possible thin sandstone dykes, and even rare tetrapod tracks. Similar spectra of sedimentary structures have been described by Stear (1978) and Smith (1993a) in association with emergent sandy palaeosurfaces in channels and around playa lakes or ponds on the Lower Beaufort floodplains of the western Great Karoo.

The uppermost Middleton Formation is beautifully exposed in long road cuttings along the R63 tar road at Bruintjieshoohte Pass, on the northern edge of the Highlands WEF project area. Features well-seen here include erosive-based channel sandstones (some clearly elliptical in geometry), prograding point bars, tabular crevasse splay sandstones and possible mudrock-infilled abandoned channels (Figs. 11 to 19). Occasional small-scale reverse faults cut the Middleton succession (Fig. 12) while contemporary Gondwana tectonism is supported by the presence in the uppermost part of the formation of an extensive exposure of a thick, pale tuff (volcanic ash) that has recently been dated to 256.25 Ma (Late Permian, Wuchiapingian) (Rubidge *et al.* 2013). A poor, highly-weathered exposure of what might be the same tuff bed is seen in the WEF project area on Spaarwater 103 (Fig. 16). Bedrock exposure along the west-facing escarpment on the western edge of the project area is generally poor with the exception of channel sandstone bodies, due to colluvial and vegetation cover (Fig. 7) but occasional exposures of crumbly grey mudrock are encountered (Fig. 13).

On the rolling plateau within the core project area Middleton Formation mudrocks are largely only seen along the more important drainage lines, including larger erosion gullies and small rivers, with relatively few hillslope exposures. Occasional thicker sections reveal massive or medium- to thin-bedded, occasionally laminated grey-green to blue-grey silty mudrocks with very subordinate purple-brown beds (Figs. 14 & 18). Horizons of large rusty-brown ferruginous concretions of dm to boulder-size in some cases represent pedogenic calcretes (when they may be fossiliferous – Section 6) (Fig. 15), but in other cases may reflect high water tables on the Late Permian floodplain. Units of massive diamictite, microbreccia and mudflake conglomerate facies are also seen, characterised by angular to rounded flakes of reworked mudrock in a poorly-sorted, fine sandy to silty matrix. Thin, sharp-based, upward-coarsening packages of overbank sediments can be recognised locally (Fig. 17). Channel sandstone bodies are broadly lenticular, erosive-based (sometimes markedly so) and current-ripple topped, reaching thicknesses of several meters. They often display a pronounced E-W parallel jointing in this area (Fig. 21). Sandstone palaeosurfaces characterised by small-scale wave ripples are quite common (Fig. 22), and often associated with vertical plant stem casts and invertebrate trace fossils (Section 6). Some darker, fine-grained

sandstones (probably impure wackes) may be difficult to distinguish from the adjacent dark grey mudrocks due to transitional contacts and loading between them (Fig. 20).

Figure 11. Excellent road cutting exposures of the uppermost Middleton Formation along the Bruintjieshoogte Pass (R63), here showing erosive gullying at the base of a major channel sandstone.

Figure 12. Small-scale reverse faulting picked out by channel sandstone displacement and brecciation, Middleton Formation, Bruintjieshoogte Pass (R63 road cutting).

Figure 13. Rare extensive exposure of crumbly overbank mudrocks and thin sandstones of the Lower Beaufort Group (probably uppermost Middleton Formation) on the west-facing escarpment bordering the Highlands WEF project area in the west (Loc. 312).

Figure 14. Unusually good gully exposures of Middleton Formation grey-green, massive to thin-bedded overbank mudrocks (Loc. 437).

Figure 15. Horizon of large, rusty-brown ferruginous carbonate concretions within Middleton Formation overbank mudrocks – possibly an indicator of a high floodplain water table (Hammer = 30 cm) (Loc. 272).

Figure 16. Rare exposure of pale-yellowish, soft-weathering tuff units (volcanic ash) within the Middelton Formation (Loc. 237a) (Hammer = 30 cm). Much better exposures of a comparable tuff horizon are seen along Bruintjieshoogte Pass.

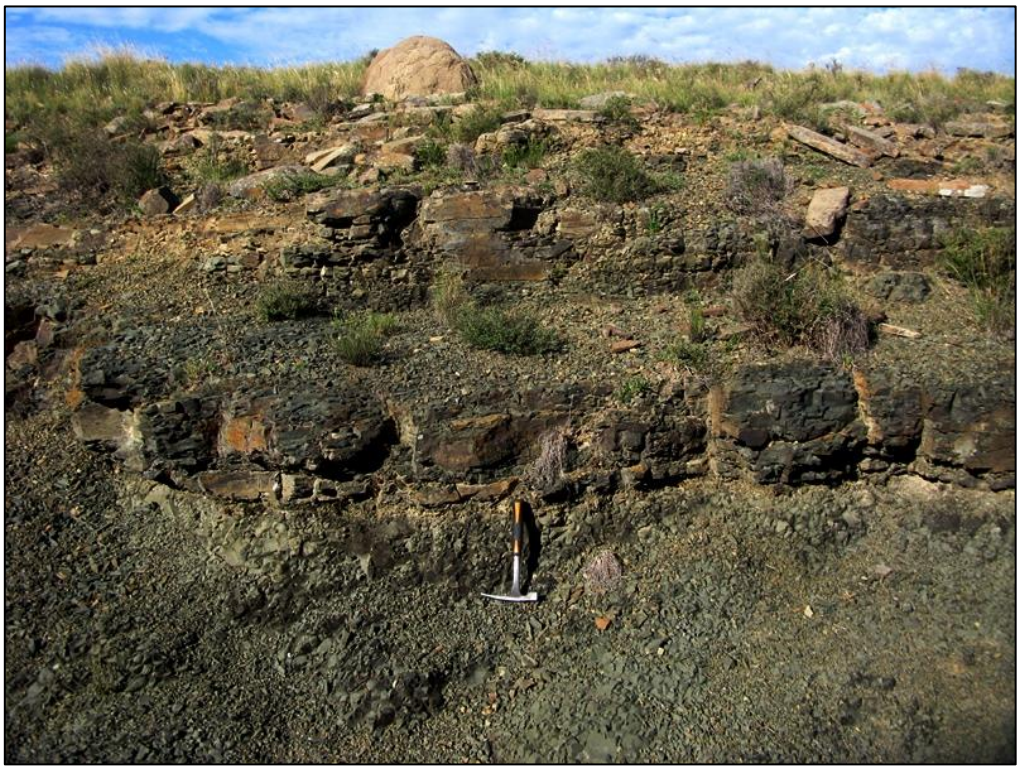

Figure 17. Thin, sharp-based upward-coarsening cycles within dark overbank fine sandstones and mudrocks of the Middleton Formation (Hammer = 30 cm) (Loc. 265). Beds rich in reedy plant stems occur slightly lower in the succession at this locality (Fig. 49).

Figure 18. Gullied hillslope exposure of purple-brown as well as grey-green overbank mudrocks of the Middleton Formation (Loc. 281).

Figure 19. Riverine cliff section through dark channel wackes and mudrocks of the Middleton Formation with a possible mudrock-infilled abandoned channel on the lower left (Loc. 282).

Figure 20. Poorly-defined, fine-grained wackes showing gradational contacts with adjacent mudrock interbeds, hillslope exposure of the Middleton Formation (Loc. 270) (Hammer = 30 cm).

Figure 21. Extensive exposure of a ripple cross-laminated channel sandstone top showing the well-developed E-W parallel jointing typical for sandstone bodies in the region, Middleton Formation (Loc. 242).

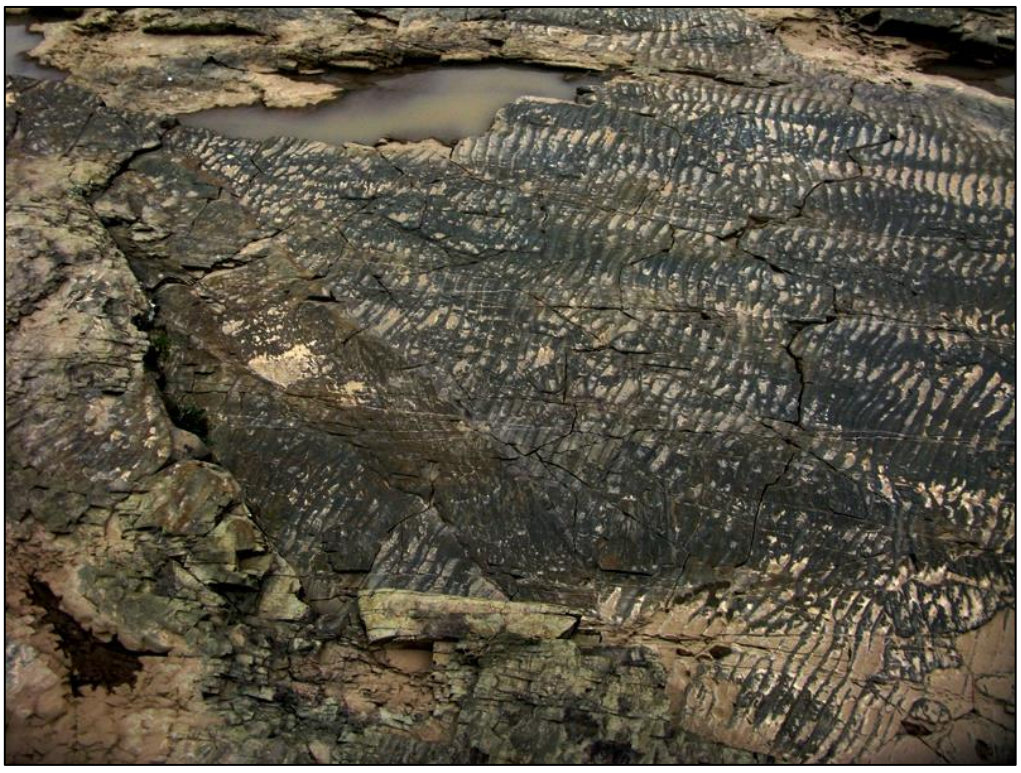

Figure 22. Beautifully-preserved small-scale wave ripples (wavelength *c*. 5 cm) preserved on an extensive sandstone palaeosurface, probably formed in a persistent shallow playa lake on the Permian floodplain (Loc. 317). Note narrow zone of ripple reworking on the left.

5.1.2. Balfour Formation

The fluvial Balfour Formation comprises recessive weathering, grey to greenish-grey overbank mudrocks with subordinate resistant-weathering, grey, fine-grained channel sandstones deposited by large meandering river systems in the Late Permian to Earliest Triassic Period (Hill 1993). The formation reaches a maximum thickness of over 2000 m in the Fort Beaufort area but is only 650 m near Graaff-Reinet (Johnson 1976, Visser & Dukas 1979). Thin wave-rippled sandstones were laid down in transient playa lakes on the flood plain. Reddish mudrocks are comparatively rare, but increase in abundance towards the top of the Adelaide Subgroup succession near the upper contact with the Katberg Formation. The base of the Balfour succession is defined by a sandstone-rich zone, some 50-100 m thick, known as the **Oudeberg Member**. The Oudeberg sandstones and interbedded mudrocks crop out along the Groot-Bruintjieshoogte Escarpment as well as within the south-western portion of the WEF project area (dark green in Fig. 4).

Key recent reviews of the Balfour Formation fluvial succession have been given by Visser and Dukas (1979), Catuneanu and Elango (2001), Katemaunzanga (2009) and Oghenekome (2012). Catuneanu and Elango (2001) identified six upward-fining depositional sequences within the Balfour succession that are separated by subaerial unconformities and lasted on average about 0.7 Ma (million years). The sequences were generated by tectonic processes within the Cape Fold Belt. Fluvial deposition by sandy braided rivers in the early part of each sequence was followed by more mixed channel sandstones and overbank mudrocks laid down by meandering rivers higher in the sequence. Sedimentological data, such as the rarity of palaeosols (fossil soils, desiccation cracks, red beds), suggest that palaeoclimates during this period were predominantly temperate to humid and water tables were generally high.

The stratigraphy and sedimentology of the five stratigraphic members recognised within the Balfour Formation in the Eastern Cape are discussed by Oghenekome (2012) and mapped for the Bedford – Adelaide area. The Oudeberg Member, a thick sandstone-dominated package at the base of the Balfour Formation succession, corresponds to Sequence ‘A’ of Catuneanu and Elango (2001). This is described as *c*. 400 m thick and composed of braided fluvial sandstones towards the base passing up to sand-bed and fine-grained meandering river deposits towards the top. The Ouderberg Member package of closely-spaced thick channel sandstones is well seen in the Bruintjieshoogte Escarpment (Fig. 6). The pale yellowish-brown Ouderberg Member channel sandstones – markedly coarser and less well-sorted (and possibly more feldspathic) than their Middleton Formation equivalents – crop out in higher ground in the south-western sector of the Highlands WEF project area (Fig. 23). They form steep, stepped hillslopes and cliffs - especially where intruded and baked by Karoo dolerites - with very little exposure of intervening mudrock facies (Fig. 24).

Figure 23. Stepped upland hillslopes in the south-western part of the WEF project area built of closely-space, pale brown, rubbly-weathering channel sandstones of the Oudeberg Member (lowermost Balfour Formation) (Loc. 310).

Figure 24. Very limited exposure of subordinate, recessive-weathering mudrocks within the Oudeberg Member (Balfour Formation). Note small-scale gully casts on the sole of the overlying channel sandstone (Loc. 311).

5.2. Karoo Dolerite Suite

The Lower Beaufort Group sediments in the study region are intruded by several major igneous bodies (sills, dykes) of the Early Jurassic **Karoo Dolerite Suite** (pink in Fig. 4). These igneous rocks do not contain fossils, so these areas are of usually insignificant palaeontological sensitivity. Furthermore, thermal metamorphism or baking by dolerite intrusions may often compromise fossil preservation within the adjacent sedimentary country rocks.

A major Karoo dolerite intrusion (possibly with both sill and dyke components) runs broadly NE to SW across the Highlands WEF project area where it bakes country rocks of both the Middleton and Balfour Formations (see geological map Fig. 4). Areas underlain by dolerite tend to have more reddish-brown hues from afar due to lateritic weathering and soils (Fig. 25). They are characterised by arrays of well-rounded dolerite corestones (often associated with more trees) and rubbly doleritic scree (Fig. 26). Country rocks are baked to hornfels and quartzite and may also be cliff-forming, as seen along the western escarpment and the Groot-Bruintjieshoogte Mountains (Figs. 6 and 27).

Figure 25. Reddish brown-hued plateau underlain by a major dolerite sill in the east-central sector of the study area (Doorn Rivier 105) (View from the N).

Figure 26. Cluster of large, rusty-brown weathering, well-rounded corestones overlying a major dolerite sill (Loc. 303).

Figure 27. Western escarpment near Mulderskraal homestead showing cliff of columnar-jointed dolerite and adjoining baked sediments of the Lower Beaufort Group (Loc. 313).

5.3. Late Caenozoic superficial sediments

A range of Late Caenozoic superficial sediments mantle most of the Palaeozoic bedrocks within the Highlands WEF project area. Thick (up to several m) bands or prisms of semi-consolidated ancient colluvial / alluvial deposits, provisionally assigned to the Late Pleistocene to Holocene **Masotcheni Formation**, occur along all major drainage lines, especially where these are floored by resistant channel sandstone bodies. The deposits are typically orange-brown, predominantly sandy with dispersed gravels clasts and poorly-sorted sandstone gravels at the base where they sharply overlie the Palaeozoic bedrocks (Figs. 28 to 31). The lower part of the profile is usually highly-calcretised, and may be crudely bedded. Zones of smaller calcrete glaebules occur higher up and there may occasionally be embedded MSA stone tools of hornfels and (rarely) volcanic tuff. The Masotcheni beds are themselves overlain by pale to dark brown sandy soils and downwasted surface gravels that are mainly of sandstone or quartzite composition with minor dolerite, hornfels and vein quartz. The polycyclic Masotcheni Formation, with multiple phases of colluvial deposition, erosional incision and palaeosol formation, occurs widely within the Main Karoo Basin of northern KZN – Free State – Eastern Cape where it is often well exposed within deep erosion gullies or *dongas* overlying the Karoo sedimentary bedrocks (Botha *et al.* 1990, Botha 1992, Johnson & Verster 1994, Lindström 1981, Partridge *et al.* 2006). Luminescence dating suggests depositional ages within the last 110 000 years (Late Pleistocene and younger), following the last glacial maximum (Wintle *et al.* 1995).

Other Late Caenozoic superficial deposits encountered within the WEF project area include gravelly to sandy alluvium along modern drainage lines (Fig. 36) and sandy diamictite-like slope deposits of probably debris flow origin (Fig. 32). Scree deposits on steeper hillslopes are variously composed of angular sandstone blocks to well-rounded dolerite corestones (Fig. 35). Large parts of the hilly upland terrain are covered with orange-brown sandy colluvial soils overlying thin, rubbly basal gravels of angular, patinated sandstone which often include stone artefacts (*e.g.* MSA, ESA) of quartzite and hornfels (Figs. 33 & 34).

Figure 28. Typical gullied exposure of orange-brown, semi-consolidated colluvial deposits of the Late Pleistocene to Holocene Masotcheni Formation overlain by dark younger soils (Loc. 292).

Figure 29. Good erosion gully sections through calcretised colluvial sediments of the Masotcheni Formation capped by greyish Recent soils (Hammer = 30 cm). (Loc. 240).

Figure 30. Well-consolidated and –bedded colluvial to alluvial sediments of the Masotcheni Formation with sparse embedded megaclasts (Loc. 274) (Hammer = 30 cm).

Figure 31. Pale brown and greyish younger colluvial to alluvial sands with horizon of calcrete glaebules and poorly-sorted sandstone basal gravels overlying Lower Beaufort Group bedrock (Loc. 254).

Figure 32. Thick sandy colluvium with dispersed sandstone gravel clasts, possibly emplaced by debris flows (Hammer = 30 cm) (Loc. 242).

Figure 33. Typical orange-brown sandy soils overlying ferruginised basal gravels seen across large parts of the project area (Hammer = 30 cm) (Loc. 233). The gravels locally contain reworked, patinated stone artefacts (sandstone, hornfels) of probable MSA and ESA age.

Figure 34. Narrow, shallow stream gulley exposures of Middleton Formation bedrocks, unusual here in showing extensive bedding planes that are ideal for fossil hunting (Loc. 297). Note thick gravelly soil cover elsewhere.

Figure 35. Angular surface gravels of sandstone and / or quartzite mantling Middleton Formation bedrocks (Loc. 290).

Figure 36. Riverbank section through semi-consolidated Quaternary to Holocene gravelly to sandy alluvium (Loc. 273).

6. PALAEONTOLOGICAL HERITAGE

The Lower Beaufort Group succession is well known for its rich fossil record of Permian vertebrates, plants and trace fossils (Rubidge 1995, Johnson *et al.* 2006, Smith *et al.* 2012). According to the available Karoo biozonation maps, fossil assemblages of the ***Cistecephalus* Assemblage Zone** associated with the uppermost part of the Middleton and lower part of the Balfour Formation that are represented in the Highlands WEF project area (Figs. 37a & 38) (Kitching 1977, Keyser & Smith 1977-1978, Hill 1993, Smith & Keyser 1995, Nicolas 2007, Van der Walt *et al.* 2010) . As shown on the SAHRIS website, the WEF study area is designated as largely being of very high palaeontological sensitivity due to the rich fossil record of terrestrial vertebrates (reptiles, therapsids, fish, amphibians), vascular plants and trace fossils reported from the Lower Beaufort Group bedrocks. Published maps of historical fossil sites show a concentration of finds along the Great Escarpment zone between Somerset East and Pearston where numerous good bedrock exposures are available (Kitching 1977, Hill 1993) (Figs. 37a & 37b).

The following major categories of fossils might be expected within *Cistecephalus* AZ sediments in the study area (Keyser & Smith 1979, Anderson & Anderson 1985, Hill 1993, Smith & Keyser *in* Rubidge 1995, MacRae 1999, Cole *et al*., 2004, Smith *et al.* 2012):

- isolated petrified bones as well as rare articulated skeletons of **terrestrial vertebrates** such as true **reptiles** (notably large herbivorous pareiasaurs, small insectivorous owenettids) and **therapsids** or “mammal-like reptiles” (*e.g.* diverse herbivorous dicynodonts, flesh-eating gorgonopsians, and insectivorous therocephalians) (Fig. 39)
- aquatic vertebrates such as large **temnospondyl amphibians** (*Rhinesuchus*, usually disarticulated), and **palaeoniscoid bony fish** (*Atherstonia*, *Namaichthys*, often represented by scattered scales rather than intact fish)
- freshwater **bivalves** (*Palaeomutela*)
- **trace fossils** such as worm, arthropod and tetrapod burrows and trackways, coprolites (fossil droppings)
- **vascular plant remains** including leaves, twigs, roots and petrified woods (“*Dadoxylon*”) of the *Glossopteris* Flora (usually sparse, fragmentary), especially glossopterid trees and arthrophytes (horsetails).

As far as the biostratigraphically important tetrapod remains are concerned, the best fossil material is generally found within overbank mudrocks, whereas fossils preserved within channel sandstones tend to be fragmentary and water-worn (Rubidge 1995, Smith 1993). Many fossils are found in association with ancient soils (palaeosol horizons) that can usually be recognised by bedding-parallel concentrations of calcrete nodules.

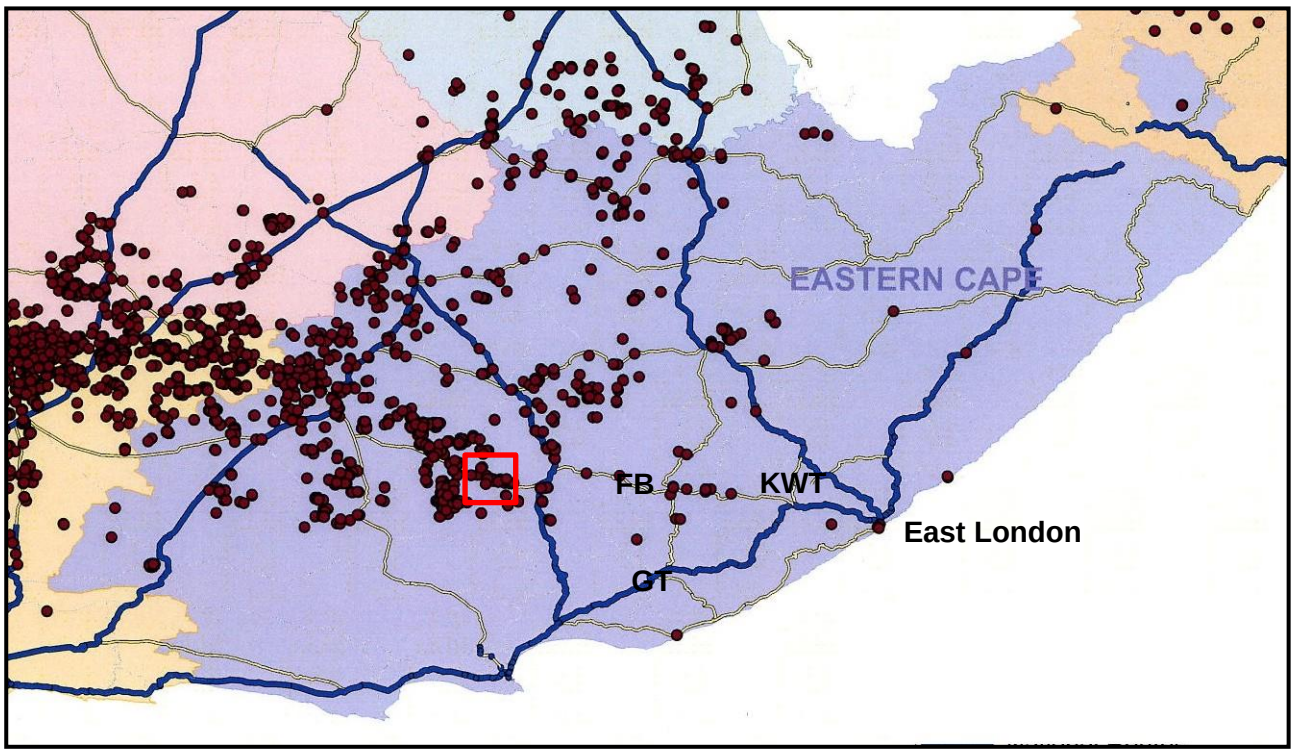

Figure 37a. Distribution of known vertebrate fossil sites in the Beaufort Group in the Eastern Cape (Modified from Nicolas 2007). Note the lack of concentration of fossil sites recorded in the Bruintjieshoogte study region between Somerset East and Pearston (red rectangle).

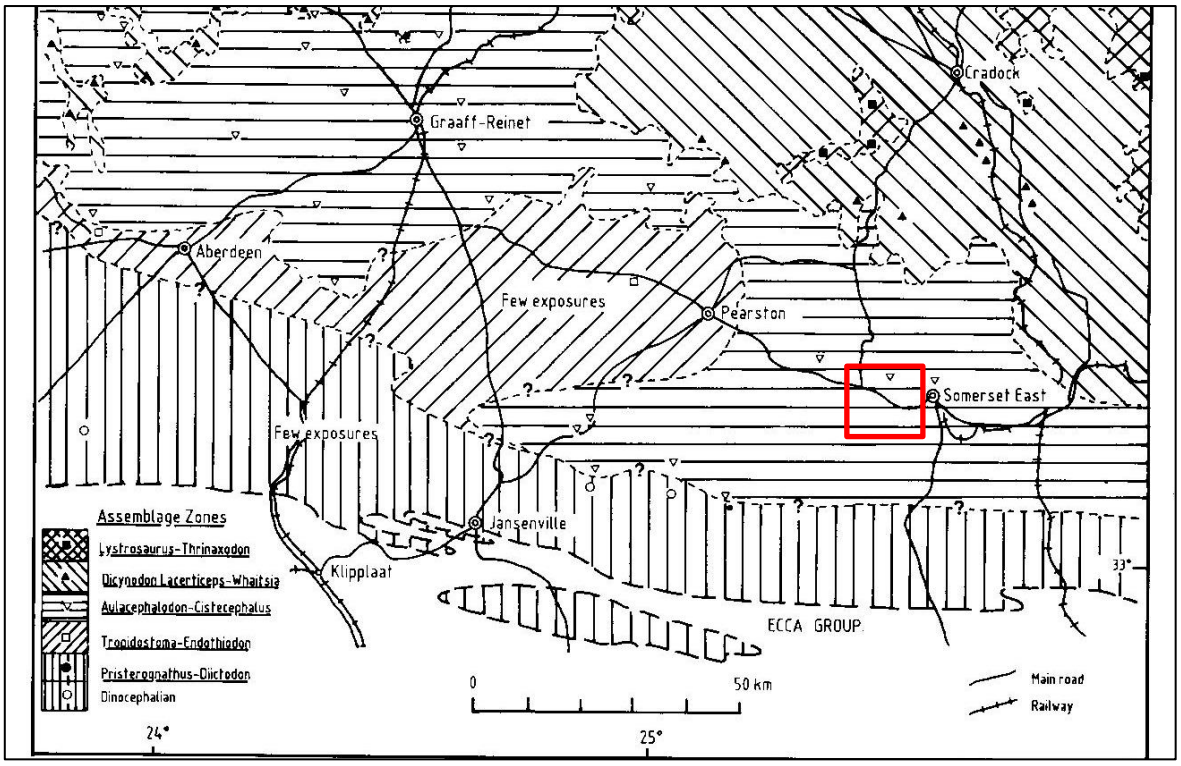

Figure 37b. Distribution of Beaufort Group fossil assemblage zones in the Graaff-Reinet sheet area (After Keyser & Smith 1977-78, Hill 1993). According to this (somewhat outdated) map the Bruintjieshoogte study area, located inside the red rectangle, lies within the *Cistecephalus* Assemblage Zone (previously known as the *Aulacephalodon* – *Cistecephalus* Zone). There are several vertebrate fossil records from the Great Escarpment zone around Bruintjieshoogte and eastwards towards Somerset East (small triangles).

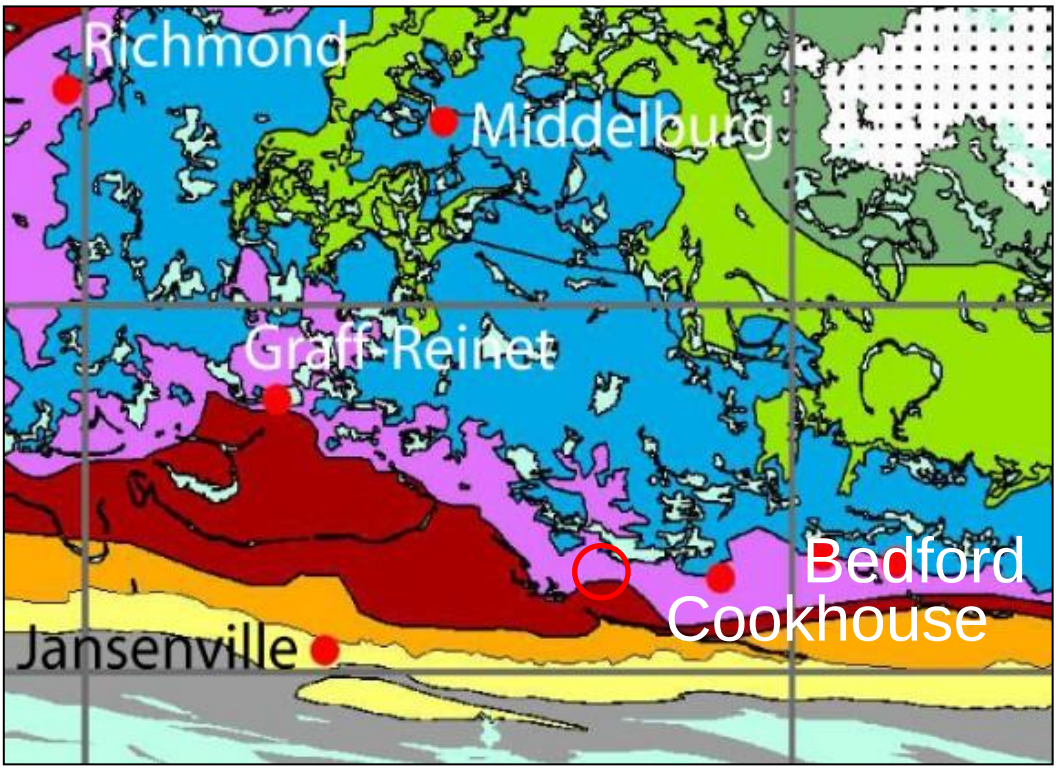

Figure 38. Extract from the most recent fossil assemblage zone map for the Main Karoo Basin showing the main biozones represented in the broader study region. The Bruintjieshoogte study area (red circle) is assigned to the *Cistecephalus* Assemblage Zone (purple area) associated with the uppermost part of the Middleton Formation and the lower part of the Balfour Formation (Map modified from Van der Walt *et al.* 2010). It is also possible that some of the stratigraphically lower-lying bedrocks within the study area fall within the comparatively fossil-poor *Tropidostoma* Assemblage Zone which is associated with the middle portion of the Middleton Formation.

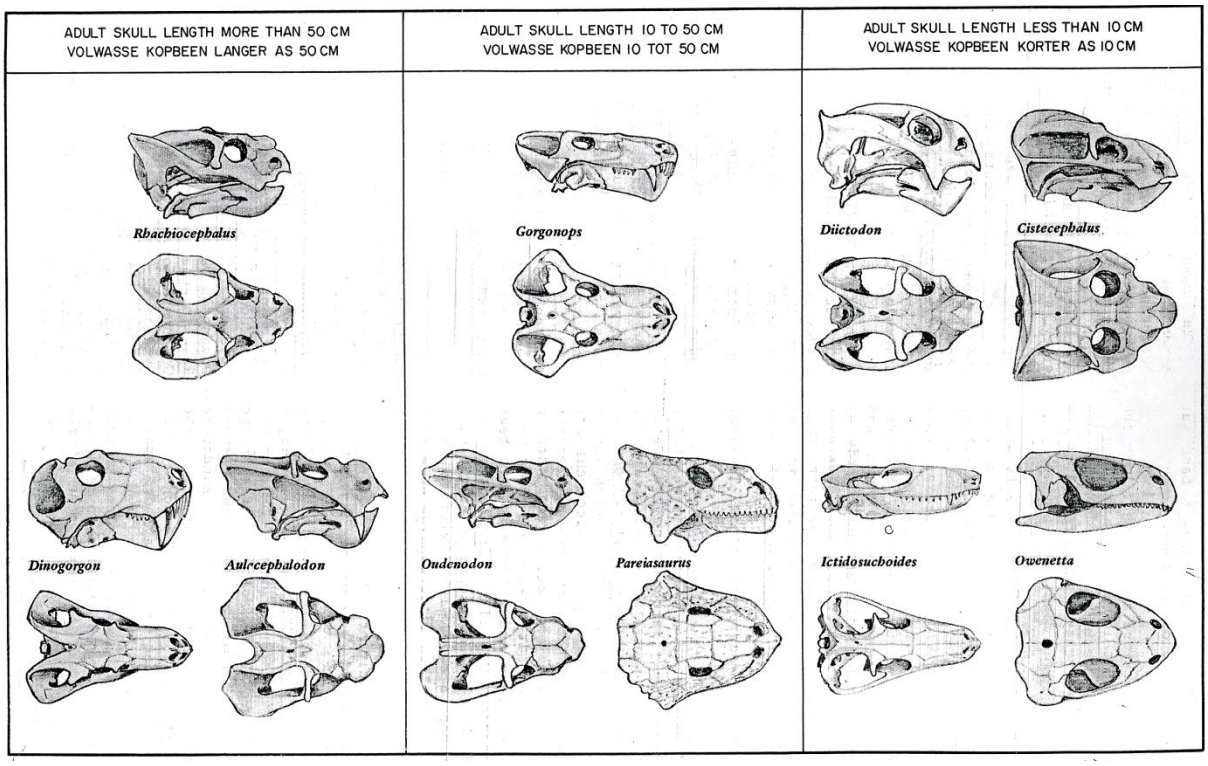

Figure 39. Skulls of characteristic fossil vertebrates from the *Cistecephalus* Assemblage Zone (From Keyser & Smith 1977-1978). *Pareiasaurus* a large herbivore, and *Owenetta*, a small insectivore, are true reptiles. The remainder are therapsids or "mammal-like reptiles". Of these, *Gorgonops* and *Dinogorgon* are large flesh-eating gorgonopsians, *Ictidosuchoides* is an insectivorous therocephalian, while the remainder are small– to large-bodied herbivorous dicynodonts.

Fossil vertebrate remains appear to be surprisingly rare in the Lower Beaufort Group outcrop area near Somerset East - Cookhouse compared to similar-aged deposits further west within the Great Karoo (Almond 2010, 2013c, 2014, 2015). The important compendium of Karoo fossil faunas by Kitching (1977) lists numerous finds from the *Cistecephalus* Assemblage Zone near Pearston. A few therapsid genera - the dicynodonts *Emydops* and *Cistecephalus plus* the therocephalian *Ictidosuchoides* – are reported from Bruintjieshoogte, between Pearston and Somerset East, although fossils are recorded as rare even here, despite the excellent level of exposure (Fig. 37b). Sparse dicynodonts are also mentioned from Bedford, *c*. 30km to the ENE of Cookhouse. Fossils of the long-ranging, small, communal burrowing dicynodont *Diictodon* are recorded from Slaghtersnek to the south of Cookhouse (precise location not provided, Kitching 1977, p. 66).

Apart from a few isolated postcranial bone fragments, no vertebrate remains were found within the Lower Beaufort Group sediments during recent palaeontological field studies for wind farm projects near Cookhouse and Bedford by De Klerk (2010) and Durand (2012). A limited number of well-preserved dicynodont skulls (probably *Oudenodon, Diictodon*) as well as scattered postcranial therapsid remains, sphenophytes (horsetail ferns), locally abundant silicified wood (some showing insect borings), and low diversity assemblages of horizontal burrows (including *Scoyenia* arthropod scratch burrows) were recorded from the Middleton Formation in the Cookhouse – Middleton area by the author (Almond 2010b, 2011, 2013c). A couple of poorly-preserved therapsid tracks are also recorded from this succession near Middleton (Prof. Bruce Rubidge, pers. comm., and Almond 2011, 2013c). The recent discovery of a specimen of the rare, turtle-like parareptile *Eunotosaurus* in the same area supports the assignation of the lower Middleton Formation succession to the *Pristerognathus* Assemblage Zone, correlated with the Poortjie Member of the Teekloof Formation of the western Main Karoo Basin (Day *et al*. 2013). No fossils were recorded from the Middleton Formation in the Nojoli WEF project area by Almond (2014) but locally abundant petrified wood material does occur within the overlying Oudeberg Member (Balfour Formation). The Balfour Formation in the adjoining Nxuba WEF project area has yielded a few fossil vertebrate localities (including the semi-articulated skeleton of a medium-sized therapsid), rare fossil invertebrate and vertebrate burrows, as well as well-preserved petrified wood and dense concentrations of woody plant moulds within the base of a channel sandstone (Almond 2015). Assignation of the tuff unit in the Bruintjieshoogte Pass to the *Cistecephalus* Assemblage Zone was supported by material of *Aulacephalodon* collected from lower-lying beds neat the pass (Prof. B. Rubidge, Wits University, pers. comm. 2018).

As with previous palaeontological assessment studies on Lower Beaufort Group rocks in the Cookhouse – Middleton – Bedford region further to the east, identifiable fossil vertebrate remains are very rare in the Highlands WEF project area (See tabulated locality data provided in Appendix 1). Only two areas have yielded fossil skeletal remains. They include a wide dicynodont skull (probably *Aulacephalodon*) and unidentified disarticulated postcrania preserved within ferruginous carbonate concretion within Middleton Formation mudrocks on Rietfontein 102 (Figs. 40 to 43) as well as a small, crushed dicynodont skull enclosed in overbank mudrocks on Coetzees Fontein 104 (Fig. 44). Several examples of possible sandstone casts of substantial (15-30 cm wide) vertebrate burrows were also recorded within the Middleton Formation (*e.g.* Figs. 46 & 47), but some of these may prove to be dubiofossils. A concentration of comparable, but more convincing, vertebrate

burrow casts are seen within Middelton Formation mudrocks on the western outskirts of Somerset East (Fig. 48). Low diversity trace fossil assemblages – mainly small, cylindrical meniscate back-filled burrows probably referable to the *Scoyenia* Ichnofacies - occur with wave rippled sandstone palaeosurfaces, reedy plant stem casts and mudcrack infills that were associated with transient playa lakes on the Permian floodplain (Figs. 45 & 50). Compression fossils and moulds of substantial sphenophyte stems up to 2 cm wide occur within dark, organic-rich mudrocks from similar lake margin and abandoned channel pond settings (Fig. 49).

Figure 40. Extensive hillslope exposure of Middleton Formation mudrocks with scattered ferruginous carbonate concretions (foreground) of probable pedogenic origin, some of which contain fossil bone (Loc. 252). See also following three figures.

Figure 41. Ferruginous carbonate concretion containing the partially-preserved broad skull of a medium-sized dicynodont (probably *Aulacephalodon*) seen with ventral side uppermost (Scale in cm) (Loc. 252).

Figure 42. Isolated limb bone of a medium-sized tetrapod (probably dicynodont), Middleton Formation (Scale in cm and mm) (Loc. 253)

Figure 43. Ferruginous carbonate concretion containing fragmentary bone material, Middleton Formation (Loc. 258) (Scale in cm and half cm).

Figure 44. Crushed skull and partial associated postcrania (*e.g.* vertebrae) of a small dicynodont, Middleton Formation (Loc. 298). Skull is *c*. 5 cm wide towards the rear.

Figure 45. Sandstone palaeosurface in the Middleton Formation with poorly-preserved meniscate back-filled invertebrate burrows (arrowed) as well as plant stem casts (Scale in cm) (Loc. 248).

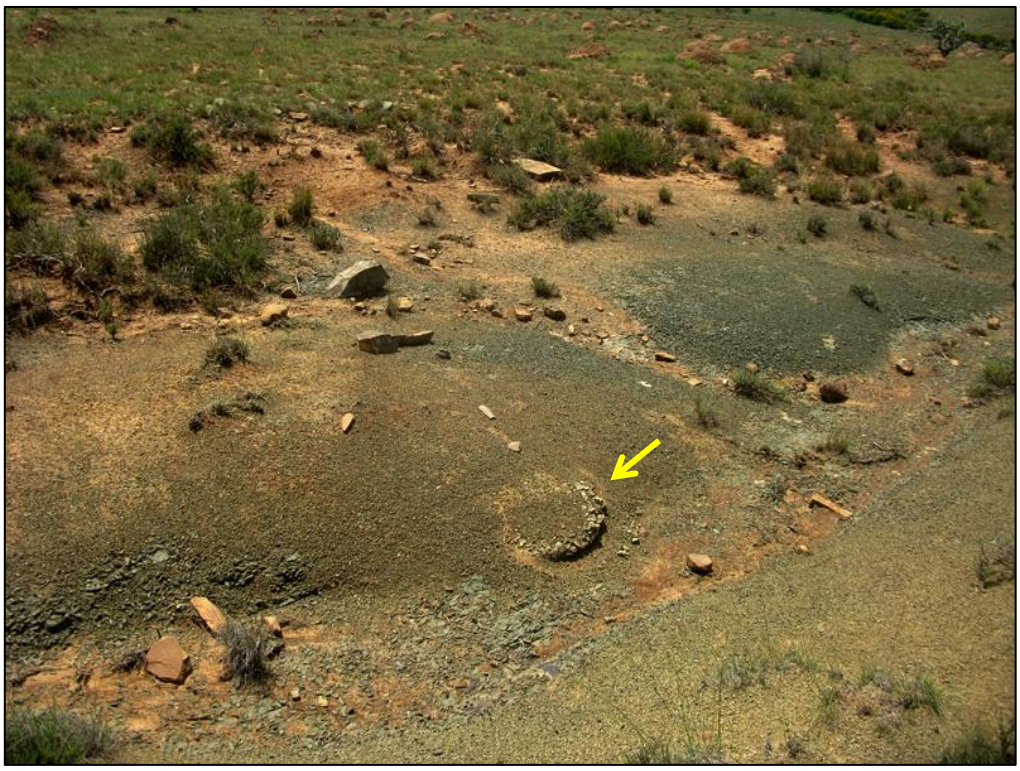

Figure 46. Prominent-weathering, convex-down sandstone body isolated within mudrock (arrowed) – *possibly* a vertebrate burrow cast, *c*. 30 cm wide, Middleton Formation (Loc. 246).

Figure 47. Convex-topped sandstone body embedded in mudrock of the Middleton Formation - *possibly* a vertebrate burrow cast (Scale in cm) (Loc. 299).

Figure 48. Two intersecting sandstone vertebrate burrow casts embedded in overbank mudrocks of the Middleton Formation, R63 road cutting on the western outskirts of Somerset East (Scale is *c*. 15 cm long).

Figure 49. Mudrock bedding plane with moulds of compressed sphenophyte fern stems up to 2 cm wide showing the characteristic fine longitudinal ribbing and stem segmentation, Middleton Formation (Loc. 265).

Figure 50. Grey overbank mudrocks of the Middleton Formation with sand-infilled dispersed plant stem casts (round in cross-section, *c*. 5 mm across) and possible desiccation cracks. Rusty hues suggest possible anoxia-related pyrite formation in a stagnant reedy swamp (Loc. 239).

7. ASSESSMENT OF IMPACTS ON PALAEONTOLOGICAL RESOURCES

The Highlands WEF project area is underlain by potentially fossiliferous bedrocks of the Lower Beaufort Group and younger superficial sediments of the Masotcheni Formation (Sections 6 & 7). Combined desktop and field studies of the project area show that *in practice* the bedrocks and superficial sediments here are generally are of *low* palaeontological sensitivity because scientifically important fossils (notably well-preserved vertebrate and vascular plant remains) are rare. The following palaeontological heritage assessment - based on the widely used Hacking approach - applies to the *construction phase* of the three WEFs and associated powerlines – as shown in Figures 51 to 53 - and takes into consideration all the relevant infrastructural components anticipated for such a project. These include *inter alia* wind turbines, hard standing areas, construction yards, access roads, underground cables and overhead powerlines as well as on-site substations and associated control buildings. Further significant impacts on fossil heritage during the operational and decommissioning phases of the wind farm are not anticipated, so these phases are not separately assessed here.

It is noted that the turbine locations shown in Figures 51 to 53 have been chosen from numerous site options following a multi-disciplinary screening process (*i.e.* they are already partially mitigated); alternative turbine layouts are therefore not being assessed here.

7.1. Impact assessment of WEFs

This assessment – summarized in Table 7.1 - applies equally to all three proposed WEFs, *viz*. Highlands North WEF, Highlands Central WEF and Highlands South WEF. There is no preference on palaeontological grounds for one or other of the Substation C1 or C2 sites under consideration.

The destruction, damage or disturbance out of context of legally-protected fossils preserved at the ground surface or below ground that may occur during *construction phase* of the WEF entail *direct negative* impacts to palaeontological heritage resources that are confined to the development footprint and limited parts of the site (*low extent*). These impacts can often be effectively mitigated but they are *permanent* (*high duration*) and cannot be fully rectified (*irreversible*). All of the sedimentary formations represented within the Highlands WEF project area contain fossils of some sort (*e.g*. microfossils, trace fossils). Impacts on fossil heritage at some level are definite but, given the general low palaeontological sensitivity of the study area, they are likely to be of *medium intensity* / severity (Impacts on highly-significant fossil remains – such as rare vertebrate fossils – cannot be completely excluded). *Without mitigation,* impacts on *scientifically important, well-preserved, unique or rare fossil material* that is worthy of special protection / conservation are *possible (medium probability)* and the overall palaeontological heritage impact significance is rated as *MEDIUM (negative)*.

With appropriate mitigation, as outlined in Section 8 below and Appendix 2 (Chance Fossil Finds Procedure), the severity of anticipated impacts as well as the probability of loss of scientifically-important fossil material are both reduced to *low*. In this case the overall palaeontological heritage impact significance is then rated as *LOW (negative)*. However, in this case any small residual impacts due to loss of fossil heritage would be partially offset by the *positive* impact represented by an improved palaeontological database for the Somerset East region as a direct result of appropriate mitigation. This is a *positive* outcome because any new, well-recorded and suitably curated fossil material from this palaeontologically under-recorded part of the Eastern Cape would constitute a useful addition to the scientific understanding of the fossil heritage here.

Given the low levels of bedrock exposure and paucity of thorough palaeontological field studies in the broader study region, confidence levels for this assessment are rated as *medium*.

When considering the **No-Go Alternative** (*i.e.* no WEF development), impacts on local fossil heritage would be essentially *neutral*. Without development natural weathering processes and erosion will continue to steadily destroy fossils preserved near or at the ground surface, but at the same time new fossils will be continually exposed. The no-go alternative would forgo potential improvements in the palaeontological understanding of the study region through any well-mitigated new fossil finds made during construction.

Table 7.1. Assessment of impacts on palaeontological heritage resources for the Highlands North WEF, Highlands Central WEF and Highlands South WEF.

Impact Phase: Construction							
Potential impact description: **Palaeontological heritage resources** Destruction, disturbance or damage of fossils preserved at or below the surface of the ground due to surface clearance and excavations during the construction phase (*e.g.* for wind turbine footings, access roads, hard standing & laydown areas, building foundations).							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	L	L	H	Negative	M	M	M
With Mitigation	L	L	H	Negative	L	L	M
Can the impact be reversed?			NO (lost fossils cannot be re-created while disturbance leads to permanent loss of contextual scientific data)				
Will impact cause irreplaceable loss or resources?			POSSIBLE but UNLIKELY (Most fossils are of widespread occurrence within the outcrop area of a given rock unit outside the project area. However, loss of unique, rare or exceptionally-preserved specimens cannot be discounted).				
Can impact be avoided, managed or mitigated?			YES – see below				
Mitigation measures to reduce residual risk or enhance opportunities: • Monitoring of all substantial excavations (*e.g.* wind turbine foundations) by ECO for fossil material on an on-going basis during construction phase. • Application of Chance Fossil Finds Procedure (See Appendix 2): safeguarding new fossil finds and reporting to ECPHRA by ECO for possible recording and sampling / collection by professional palaeontologist.							

7.2. Impact assessment of Grid Connections

For each grid connection application (one per WEF) *two* alternative route alignments are being assessed, as outlined in Figures 51 to 53. The rationale for these assessments – summarized in Tables 7.2.& 7.3 - closely follows that outlined earlier for the WEFs (*e.g.* palaeontological impacts are generally *site specific* but *permanent*). However, given (1) the small scale of excavations for the powerline pylon footings, (2) the shortness of the lines, as well as (3) the low density of

sensitive fossil sites recorded within the various grid connection corridors under consideration, the *intensity* of anticipated palaeontological impacts is rated as *low* even without mitigation. The only exception is the Highlands North WEF grid connection Alternative 2 where several vertebrate fossils are recorded within a small area inside the powerline corridor (yellow area marked in Fig. 51). Mitigation through site avoidance (*i.e.* no disturbance or new infrastructure either side of existing farm track near fossil sites) or, failing that, pre-construction collection and recording by a professional palaeontologist is acceptable here.

In the case of the Highlands Central WEF and Highlands South WEF there is no preference on palaeontological grounds for one or other route alignment, while for Highlands North WEF the Alternative 1 route alternative is preferred.

Table 7.2. Electrical grid connection for Highlands North WEF

Impact Phase: Construction							
Potential impact description: **Palaeontological heritage resources** Destruction, disturbance or damage of fossils preserved at or below the surface of the ground due to surface clearance and excavations during the construction phase (*e.g.* for pylon footings, access roads).							
GRID ALTERNATIVE 1							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	L	L	H	Negative	L	L	M
With Mitigation	L	L	H	Negative	L	L	M
GRID ALTERNATIVE 2							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	M	L	H	Negative	M	L	M
With Mitigation	L	L	H	Negative	L	L	M
Can the impact be reversed?			NO (lost fossils cannot be re-created while disturbance leads to loss of contextual scientific data)				
Will impact cause irreplaceable loss or resources?			POSSIBLE but UNLIKELY (Most fossils are of widespread occurrence within the outcrop area of a given rock unit outside the project area. However, loss of unique, rare or exceptionally-preserved specimens cannot be discounted).				
Can impact be avoided, managed or mitigated?			YES – see below				
Mitigation measures to reduce residual risk or enhance opportunities: • *Avoidance of palaeontologically sensitive fossil sites within Alternative 2 grid corridor (yellow area marked in Fig. 51). Failing that, mitigation through pre-construction collection and recording by palaeontological specialist is acceptable.* • Monitoring of all substantial excavations (*e.g.* wind turbine foundations) by ECO for fossil material on an on-going basis during construction phase. • Application of Chance Fossil Finds Procedure (See Appendix 2): safeguarding new fossil finds and reporting to ECPHRA by ECO for possible recording and sampling / collection by professional palaeontologist.							

Table 7.3. Electrical grid connection for Highlands Central WEF & Highlands South WEF

Impact Phase: Construction							
Potential impact description: **Palaeontological heritage resources** Destruction, disturbance or damage of fossils preserved at or below the surface of the ground due to surface clearance and excavations during the construction phase (*e.g.* for pylon footings, access roads).							
GRID ALTERNATIVE 1							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	L	L	H	Negative	L	L	M
With Mitigation	L	L	H	Negative	L	L	M
GRID ALTERNATIVE 2							
	Intensity	**Extent**	**Duration**	**Status**	**Probability**	**Significance**	**Confidence**
Without Mitigation	L	L	H	Negative	L	L	M
With Mitigation	L	L	H	Negative	L	L	M
Can the impact be reversed?			NO (lost fossils cannot be re-created while disturbance leads to loss of contextual scientific data)				
Will impact cause irreplaceable loss or resources?			POSSIBLE but UNLIKELY (Most fossils are of widespread occurrence within the outcrop area of a given rock unit outside the project area. However, loss of unique, rare or exceptionally-preserved specimens cannot be discounted).				
Can impact be avoided, managed or mitigated?			YES – see below				
Mitigation measures to reduce residual risk or enhance opportunities: • Monitoring of all substantial excavations (*e.g.* wind turbine foundations) by ECO for fossil material on an on-going basis during construction phase. • Application of Chance Fossil Finds Procedure (See Appendix 2): safeguarding new fossil finds and reporting to ECPHRA by ECO for possible recording and sampling / collection by professional palaeontologist.							

7.3. Cumulative impacts

For the purposes of assessing cumulative impacts resulting from the proposed Highlands WEFs and their associated grid connections previous palaeontological heritage assessments for comparable WEF projects in the broader Cookhouse - Middleton – Bedford region have been taken into account. These include the Amakhala Emoyeni WEF (De Klerk 2010), Cookhouse WEF (Almond 2009, 2010b, Durand 2010), Middleton WEF (Almond 2011, 2013c), Spitskop WEF (Almond 2013a), Nojoli WEF (Almond 2014) and Nxuba WEF (Almond 2015). While most of these lie outside the proposed 35 km radius for inclusion in the cumulative impact assessment, they nevertheless affect the same rock units – and therefore comparable fossil assemblages – as those impacted by the proposed Highlands WEFs. A separate palaeontological impact assessment for the solar farm on Kraan Kuil 50 near Pearston is not available and may well not have been carried out. It is noted that any rational assessment of cumulative impacts on fossil resources would need

to consider all developments involving substantial bedrock excavation and not just alternative energy developments.

In the case of all the WEF palaeontological assessments listed above *scientifically important* fossil material – most notably *well-preserved* vertebrate remains and plant material including petrified wood - proved very sparse. *Provided that* the recommended mitigation measures have been, or will be, consistently implemented, residual impacts should be of low (negative) significance overall. In this context it is concluded that the cumulative impact significance of the proposed Highlands WEFs and associated grid connections - considered individually as well as *en bloc* - is LOW. It can be argued that, following effective mitigation, our scientific understanding of the palaeontology of this region of the Eastern Cape could be markedly improved – a positive cumulative impact outcome that would partially offset the inevitable loss of fossils during WEF construction.

The confidence for this cumulative impact assessment is *medium*.

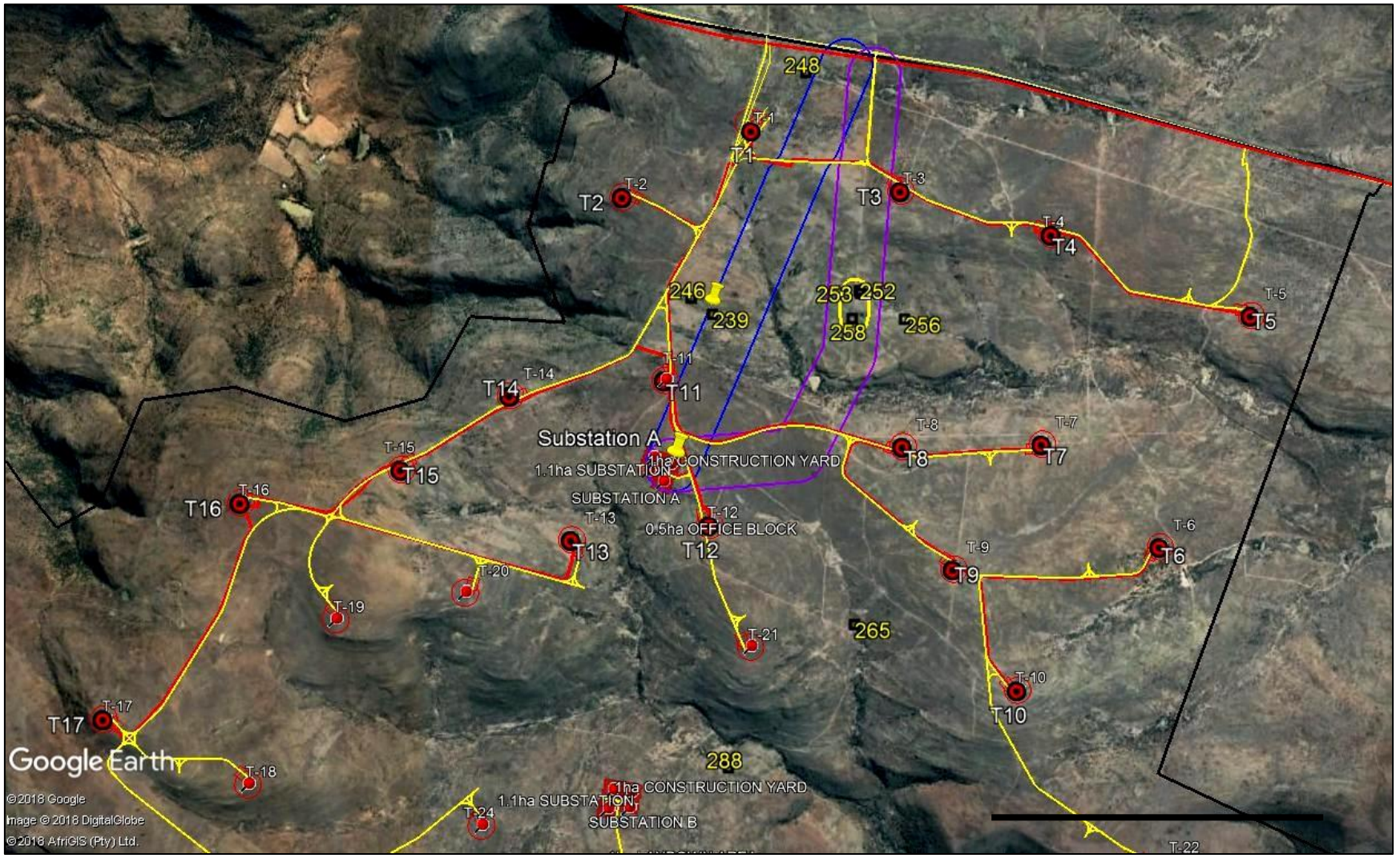

Figure 51. Google Earth© satellite image of the proposed Highlands North WEF project layout in relation to recorded fossil sites (yellow-numbered squares). Shown here is the on-site Substation A, construction yard and office block, turbine positions (red spots), grid connection Alternative 1 (blue) and Alternative 2 (purple) as well as access roads (red and yellow lines). The small yellow area enclosing fossil sites 252, 253 & 258 is palaeontologically-sensitive. If grid connection route Alternative 2 is chosen (purple), these sites should be avoided or, failing that, professionally mitigated. Other fossil sites are of low conservation value. Scale bar = 2 km. N towards top of image.

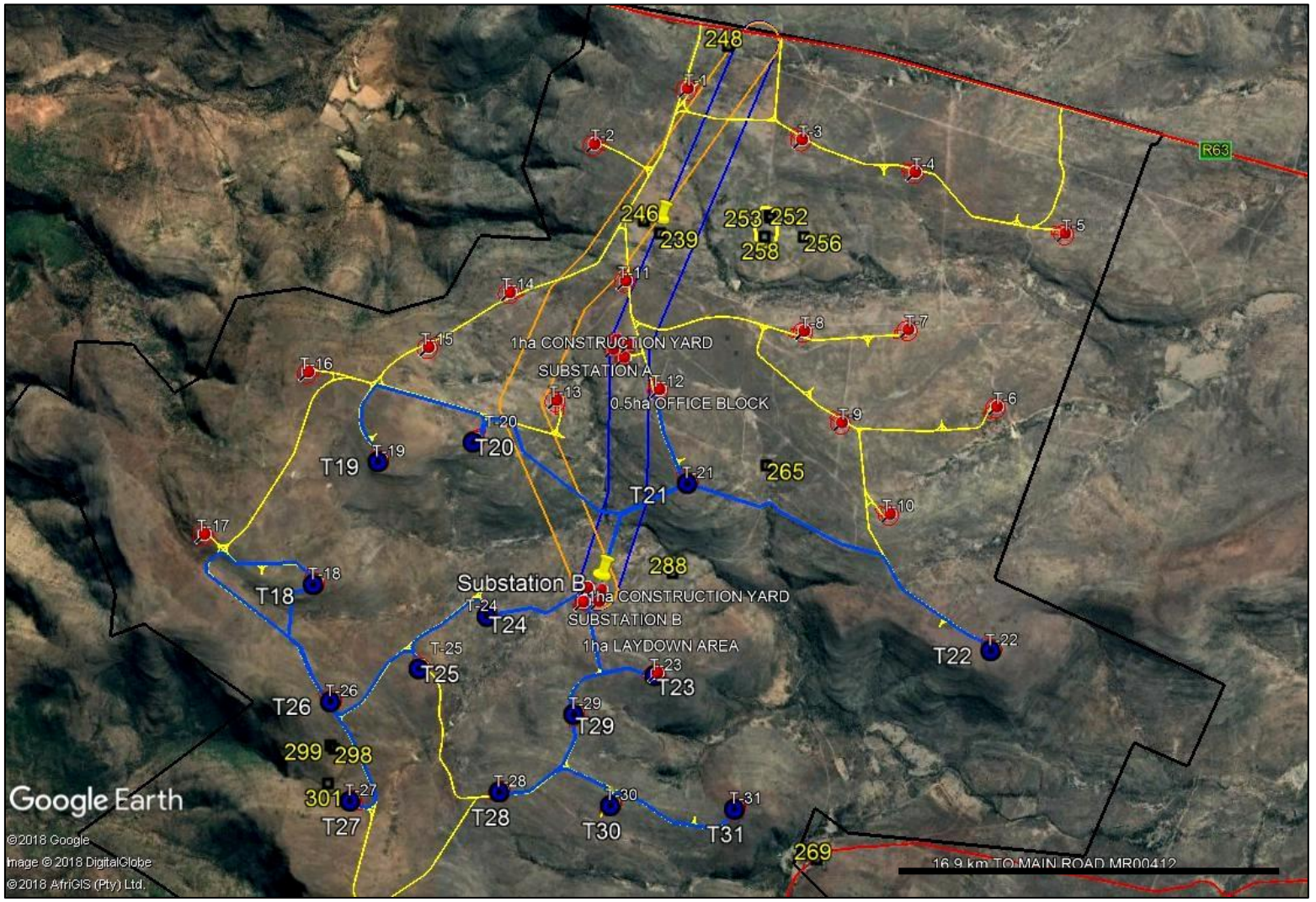

Figure 52. Google Earth© satellite image of the proposed Highlands Central WEF project layout in relation to recorded fossil sites (yellow-numbered squares). Shown here is the on-site Substation B, construction yard and laydown area, turbine positions (blue spots), grid connection Alternative 1 (blue) and Alternative 2 (orange) as well as access roads (blue and yellow lines). The small yellow area enclosing fossil sites 252, 253 & 258 is palaeontologically-sensitive. Other fossil sites are of low conservation value. Scale bar = 3 km. N towards top of image.

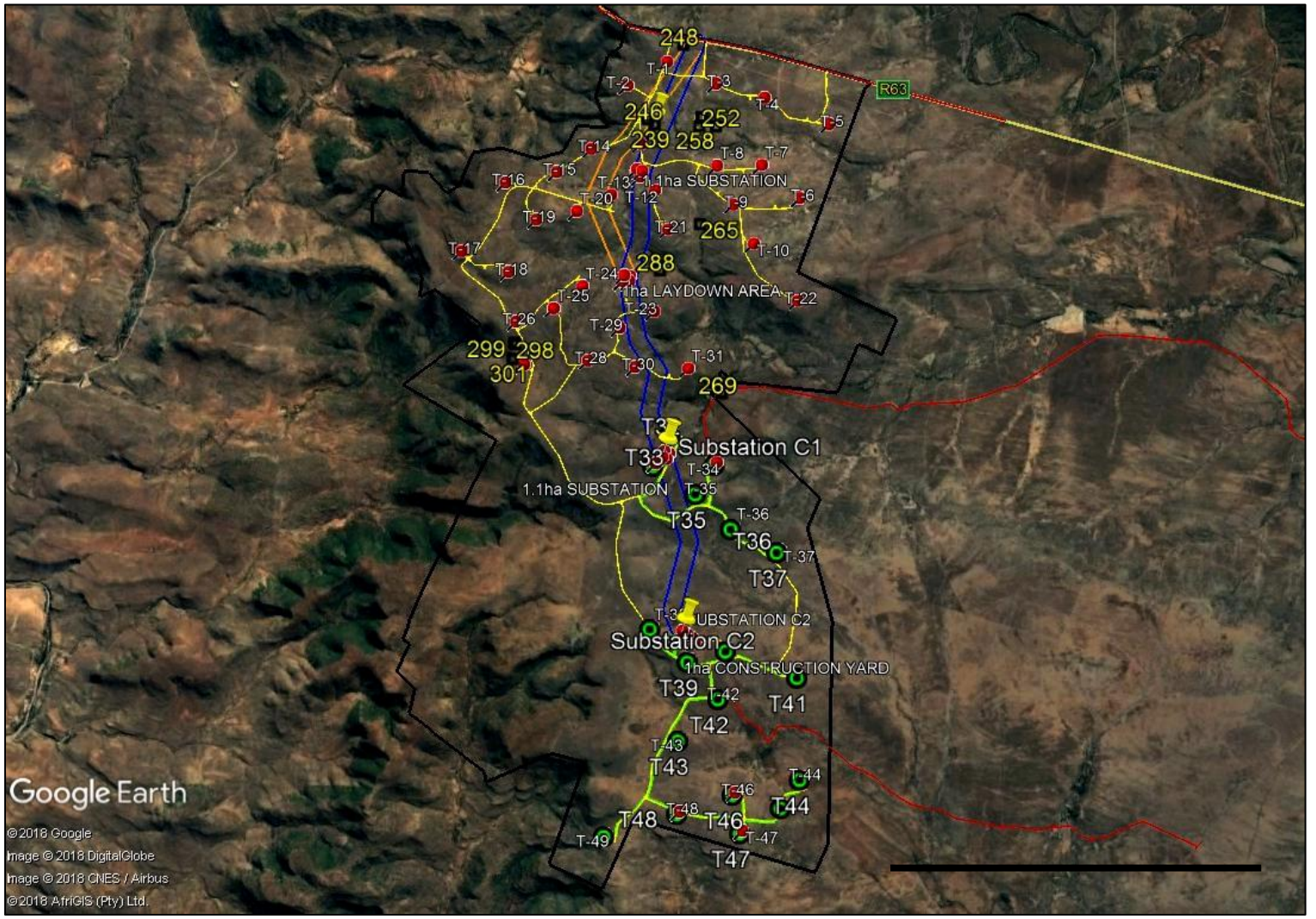

Figure 53. Google Earth© satellite image of the proposed Highlands South WEF project layout in relation to recorded fossil sites (yellow-numbered squares). Shown here is the on-site Substation options C1 & C2, construction yard, turbine positions (green spots), grid connection Alternative 1 (blue) and Alternative 2 (orange) as well as access roads (green and yellow lines). The small yellow area enclosing fossil sites 252, 253 & 258 is palaeontologically-sensitive. Other fossil sites are of low conservation value. Scale bar = 7 km. N towards top of image.

8. RECOMMENDED MONITORING AND MITIGATION (FOR INCLUSION IN ENVIRONMENTAL MANAGEMENT PROGRAMME)

Pending the potential discovery of significant new fossil remains (*e.g.* vertebrate bones, teeth, burrows and trackways, petrified wood, plant compressions) during the construction phase of the Highlands WEFs and the associated grid connections, no further specialist palaeontological studies or mitigation are recommended for this alternative energy project. The only exception would apply should the Highlands North WEF Alternative 2 grid corridor be chosen. In this case either (1) avoidance (*i.e.* no disturbance or new infrastructure either side of existing farm track near fossil sites) of recorded sensitive fossil sites within the grid corridor (outlined in yellow in Fig. 51) or, alternatively, (2) collection and recording of fossils here by a professional palaeontologist in the pre-construction phase is recommended.

The suitably qualified and experienced Environmental Control Officer (ECO) responsible for the WEF and grid connection construction phase should be made aware of the potential occurrence of scientifically-important fossil remains within the development footprint. During the construction phase all major clearance operations (*e.g.* for new access roads, turbine placements, electrical pylons, substations and other buildings) and deeper (> 1 m) excavations should be monitored for fossil remains on an on-going basis by the ECO. Should substantial fossil remains be encountered at surface or exposed during construction, the ECO should safeguard these, preferably *in situ*. They should then alert the Eastern Cape Provincial Heritage Resources Agency, ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; smokhanya@ecphra.org.za) as soon as possible. This is to ensure that appropriate action (*i.e.* recording, sampling or collection of fossils, recording of relevant geological data) can be taken by a professional palaeontologist at the proponent's expense. These recommendations are summarized in the tabulated Chance Fossil Finds Procedure appended to this report (Appendix 2).

The palaeontologist concerned with any mitigation work will need a valid fossil collection permit from ECPHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies developed by SAHRA (2013).

These monitoring and mitigation recommendations are to be incorporated into the Environmental Management Programme (EMPr) for the Highlands WEFs and associated grid applications. The operational and decommissioning phases of the developments are unlikely to have further significant impacts on palaeontological heritage and no additional recommendations are made in this regard (*N.B.* The Chance Fossil Finds Procedure still applies).

9. CONCLUSIONS

The palaeontological heritage assessment provided in this report applies to the Final Mitigated Layout of the Highlands WEFs and associated grid connections.

The Highlands WEF and grid connection project area near Somerset east is underlain at depth by potentially-fossiliferous fluvial sediments of the Karoo Supergroup (Adelaide Subgroup) assigned to the Late Permian Middleton and Balfour Formations of Late Permian age. Bedrock exposure levels here are very limited due to extensive cover by soils and coarse gravels as well as well-developed, semi-consolidated colluvial / alluvial deposits of the Pleistocene to Holocene

Masotcheni Formation along major drainage lines. The Lower Beaufort Group sediments around Bruintjieshoogte are characterised by sparse fossil vertebrates (especially therapsids) of the Late Permian *Cistecephalus* Biozone, plants and petrified wood of the Gondwanan *Glossopteris* Flora, as well as rare tuffs (volcanic ashes) of importance for radiometric dating. However, during a five-day field study of the Highlands WEF project area the only fossil remains recorded comprised very rare therapsid skeletal remains (including two skulls and unidentified postcrania) within ferruginous carbonate concretions, several putative large (*c.* 15-30 cm wide) vertebrate burrows, rippled sandstone paleosurfaces associated with reedy plant stem casts and invertebrate burrows, and concentrations of sizeable (2 cm-wide) sphenophyte fern stem impressions (horsetails) – all from the Middleton Formation - but no petrified wood. It is concluded that the project area is largely of *low* palaeontological sensitivity. Significant impacts on thick, potentially-fossiliferous of the Masotcheni Formation along major stream valleys are not anticipated. No fossil material – such as bones and teeth of extinct mammals or reworked petrified wood – was recorded within these Pleistocene - Holocene colluvial / alluvial deposits.

Potential impacts to fossil heritage resources within the Highlands WEF and grid connection area involve the disturbance, damage or destruction of fossil material at or below the ground surface within the development footprint during the construction phase (*e.g.* for wind turbine footings, access roads). Due to the recorded, albeit sparse, occurrence of rare vertebrate fossils (skeletal remains and burrows) of scientific importance within the WEF project area, potential impacts on palaeontological heritage during the construction phase of the Highlands North WEF, Highlands Central WEF and Highlands South WEF are assessed as of *medium* (*negative*) significance without mitigation, falling to *low* (*negative*) significance if the proposed mitigation measures are fully implemented. The No-go alternative (*i.e.* no WEF) would have a neutral impact on palaeontological heritage. There is no preference on palaeontological grounds for one or other of the Substation C1 or C2 sites under consideration.

The impact significance of all grid connection route alternatives under consideration is rated as low (negative), before and after mitigation, given (1) the small scale of excavations for the powerline pylon footings, (2) the shortness of the lines, as well as (3) the low density of sensitive fossil sites recorded within the various grid connection corridors under consideration. The only exception is the Highlands North WEF grid connection Alternative 2 where several vertebrate fossils are recorded within a small area inside the powerline corridor (small yellow area on farm Rietfontein 102 outlined in Fig. 51). Here impact significance is assessed as medium (negative) before mitigation falling to low (negative) after mitigation. Mitigation through site avoidance (*i.e.* no disturbance or new infrastructure either side of existing farm track near fossil sites) or, failing that, pre-construction collection and recording of fossils by a professional palaeontologist is acceptable here. In the case of the Highlands Central WEF and Highlands South WEF there is no preference on palaeontological grounds for one or other route alignment, while for Highlands North WEF the Alternative 1 route alternative is preferred.

Cumulative impacts posed by the three Highlands WEF projects and their associated grid connections, individually and collectively, are inferred to be *low* in the context of several other approved or proposed WEF developments assessed in the broader Somerset East – Cookhouse – Middleton region. Given the poor bedrock exposure levels and lack of intensive palaeontological research in the region, confidence levels for this impact assessment are *medium*.

Pending the potential discovery of significant new fossil remains (*e.g.* vertebrate bones and teeth, burrows, trackways, plant fossils including petrified wood) during the construction phase of the Highlands WEF and grid connection, no further specialist palaeontological studies or mitigation are recommended for this project in the construction phase. There are no fatal flaws to the proposed

wind farm project as far as fossil heritage is concerned. Providing that the Chance Fossil Finds Procedure outlined below and tabulated in Appendix 1 is followed through, there are no objections on palaeontological heritage grounds to authorisation of the Highlands North WEF, Highlands Central WEF and Highlands South WEF and their associated grid connections.

The suitably qualified and experienced Environmental Control Officer (ECO) responsible for the wind farm development construction phase should be made aware of the potential occurrence of scientifically-important fossil remains within the development footprint. During the construction phase all major clearance operations (*e.g.* for new access roads, turbine placements) and deeper (> 1 m) excavations should be monitored for fossil remains on an on-going basis by the ECO. Should substantial fossil remains be encountered at surface or exposed during construction, the ECO should safeguard these, preferably *in situ*. They should then alert the Eastern Cape Provincial Heritage Resources Agency, ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; smokhanya@ecphra.org.za) as soon as possible. This is to ensure that appropriate action (*i.e.* recording, sampling or collection of fossils, recording of relevant geological data) can be taken by a professional palaeontologist at the proponent's expense. These recommendations are summarized in the tabulated Chance Fossil Finds Procedure appended to this report (Appendix 2).

The palaeontologist concerned with any mitigation work will need a valid fossil collection permit from ECPHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies developed by SAHRA (2013).

These monitoring and mitigation recommendations are to be incorporated into the Environmental Management Programme (EMPr) for the Highlands WEF developments, including the associated grid connections. The operational and decommissioning phases of this development are unlikely to have further significant impacts on palaeontological heritage and no additional recommendations are made in this regard (The Chance Fossil Finds Procedure tabulated in Appendix 2 still applies).

Table 9.1. Summary significance table: palaeontological heritage impacts (construction phase)

Project		Impact significance		Recommended mitigation	
		Before mitigation	After mitigation		
Highlands N WEF		MEDIUM	LOW	No specialist mitigation	Apply Chance Fossil Finds Procedure (Appendix 2)
Highlands N grid connection	**Alt.1**	LOW	LOW	No specialist mitigation	
	Alt.2	MEDIUM	LOW	Avoid[1] or professionally mitigate documented vertebrate fossil sites within corridor	
Highlands C WEF		MEDIUM	LOW	No specialist mitigation	
Highlands C grid connection	**Alt.1**	LOW	LOW	No specialist mitigation	
	Alt.2	LOW	LOW	No specialist mitigation	
Highlands S WEF		MEDIUM	LOW	No specialist mitigation	
Highlands C grid connection	**Alt.1**	LOW	LOW	No specialist mitigation	
	Alt.2	LOW	LOW	No specialist mitigation	

1. *i.e.* no disturbance of new infrastructure either side of existing farm road close to fossil sites.

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13. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest, Gauteng, KwaZulu-Natal and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

Dr John E. Almond
Palaeontologist
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APPENDIX 1: GPS LOCALITY DATA FOR NUMBERED GEOLOGICAL & PALAEONTOLOGICAL SITES

All GPS readings were taken in the field using a hand-held Garmin GPSmap 62sc instrument. The datum used is WGS 84.

Note that locality data for South African fossil sites in *not* for public release due to conservation concerns.

Loc.	GPS data	Comments
229	S32° 40' 48.2" E25° 20' 40.0"	Views of Bruintjieshoogte Pass (Middleton Fm). Oudeberg Mb sandstone package on lower slopes of Groot-Bruintjieshoogte Mountains. Thick dolerite sill on crest of Great Escarpment forms high cliff, together with underlying baked hornfels / quartzites of Balfour Fm (probably mudrock-dominated Daggaboersnek Mb). Good road cuttings through Middleton Fm in pass along R63 show thinly-bedded, tabular, grey to grey-green overbank mudrocks and numerous thin channel sandstones, crevasse splay sandstones. Several sharp-based lenticular channel bodies showing lateral accretion of point bars. West-facing low escarpment south of R63 on W edge of WEF project area shows finely-stepped slopes due to numerous channel sandstone bodies in Middleton Fm. Generally very low levels of bedrock exposure (esp. of overbank mudrock facies). N. of R63 on Rietfontein 102 are stream gullies with thick alluvium incl. brownish-weathering Masotcheni Fm facies, extensive low gullied exposures of grey uppermost Middleton Fm mudrocks.
230	S32° 41' 38.7" E25° 21' 24.9"	Spaarwater 103. Views of hilly WEF study area, gently grassy slopes with patches of acacia, especially along drainage lines. Grassy slopes dotted with large brownish domical termitaria. Minimal bedrock exposure.
231	S32° 41' 50.2" E25° 21' 17.9"	Spaarwater 103. Shallow earth dams show considerable depth (several m) of thick, brownish sandy soils with sparse fine gravels in region. Basal rubbly colluvial sandstone gravels are angular, poorly-sorted, mainly ferruginised sandstone *plus* grey-green siltstone. Overlain by gritty to sandy older soil and paler, less gritty modern soil.
232	No data (gps error)	Spaarwater 103. Shallow hillslope and gully exposures of hackly, grey-green mudrocks of Middleton Fm. Small pale to dark grey-brown pedogenic palaeocalcrete concretions. Sparse surface scatter of downwasted sandstone blocks, patinated hornfels and sandstone artefacts (incl. MSA blades, possible ESA biface).
233	No data (gps error)	Spaarwater 103. Shallow gulley on NW side of track incised into hackly, grey-green mudrocks of Middleton Fm. Overlain by colluvial sands (possible palaeogulley infill) with ferruginised, dark brown-patinated, rubbly sandstone clasts, sparse calcrete glaebules. Weathered patinated hornfels, quartzite stone artefacts eroding out of basal gravels suggesting a probable Pleistocene age.
234	S32° 42' 07.2" E25° 20' 56.4"	Spaarwater 103. Viewpoint SW near small dam down western escarpment. Prominent-weathering channel sandstones of Middleton Fm but mudrock facies not exposed.
235	No data (gps error)	Spaarwater 103. Hilltop views of project area. Bedrocks largely soil-covered on gentle hillslopes. Thick brown sandy soils with downwasted angular sandstone blocks forming sparse surface gravels, blocky sandstone colluvium in vicinity of well-jointed (E-W), thin channel sandstone ridges (pale brown, thin- to medium-bedded, medium-grained sandstone). Occasional dark rusty-brown *koffieklip* (ferruginous limestone) clasts in surface gravels.
236	S32° 41' 52.5" E25° 21' 23.9"	Spaarwater 103. Stream gulley exposure of Middleton Fm thick, hackly grey-green mudrocks, finely-jointed, fine-grained sandstones (probably crevasse splays).
237	S32° 42' 06.7" E25° 21' 09.6"	Spaarwater 103. Excellent, extensive stream gulley and hillslope exposures of Middleton Fm, dominated by grey-green hackly-weathering mudrock facies, massive to obscurely thin-bedded. Occasional rusty-brown ferruginised calcrete lenses or concretions, small grey palaeocalcrete nodules. Sandstone component very minor. Stone artefacts (quartzite, hornfels) weathering out of overlying colluvial gravels and soils. Surface gravels of sandstone, hornfels, minor vein quartz and occasional dolerite corestones.
237a	S32° 42' 10.1" E25° 21' 15.6"	Spaarwater 103. Same gulley. Occasional thin (*c*. 10 cm), prominent-weathering, tabular, fine-grained, greyish (pale yellowish-brown-weathering) crevasse splay

		units as well as thin channel sandstone bodies within Middleton Fm. Possible thin tuff unit (see also next locality).
238	S32° 42' 10.9" E25° 21' 18.3"	Spaarwater 103. Poorly-exposed horizon (*c*. 20 cm) of pale buff, soft (recessive-weathering), crumbly, speckled material interpreted as probable tuff (volcanic ash bed). *Possibly* correlated with 256.25 Ma dated tuff unit reported from Rietfontein 102 (N of R63) by Rubidge *et al.* (2013) or may be a separate unit.
239	S32° 42' 11.3" E25° 21' 19.1"	Spaarwater 103. Polygonal mudcracks within Middleton Fm mudrocks associated with dispersed cylindrical sandstone casts of reedy plant stems (probably sphenophytes / horsetail ferns) (*Proposed Field Rating IIIC Local Resource. Site inside margins of powerline corridor alternative. No mitigation required*). Massive beds of greyish impure sandstone with suspended angular darker mudflakes (diamictite or debrite facies). Exposures of Middleton Fm unconformably overlain by thick (several m), extensively gullied, orange-brown-hued colluvial sediments of the Pleistocene Masotcheni Fm.
240	S32° 42' 12.9" E25° 21' 20.0"	Spaarwater 103. Deep (up to 5. m) gullies exposures of pale brownish, well-bedded Masotchini Fm overlain by paler and then darker brown soils. Basal rubbly, angular sandstone gravels overlie bedrock (jointed channel sandstone forming resistant bench here). Lower portion of Masotcheni succession with abundant irregular, cream-coloured calcrete bodies, enclosed angular gravels of sandstone and hornfels (including occasional flaked artefacts). Channel-infill deposits within Masotcheni composed of fine, angular mudflakes, *plus* small sandstone and hornfels clasts.
241	S32° 42' 13.8" E25° 21' 23.4"	Spaarwater 103. Thicker channel sandstone bodies within Middleton Fm poorly-exposed, highly-jointed, rubbly-weathering. Underlying grey-green as well as occasional purple-brown mudrocks contain possible boulder-sized, rounded, ferruginised load balls traversed by a polygonal network of calcite veins. Loading suggests high water tables and soupy substrates on Permian floodplain.
242	S32° 42' 15.4" E25° 21' 25.4"	Spaarwater 103. Extensively exposed top of Middleton Fm channel sandstone (current ripple cross-laminated) showing regular parallel jointing. Orange-brown colluvial gritty sands with embedded angular sandstone clasts (*c*. 1.5 m thick). Such massive sands and matrix-supported gravels may be of debris flow origin.
243	S32° 42' 16.0" E25° 21' 27.2"	Spaarwater 103. Package of orange-brown, semi-consolidated colluvial to alluvial sands and coarse, rubbly sandstone surface gravels (*c*. 1.5 to 2 m thick in total) sharply, erosively overlying channel sandstone and weathered, thin-bedded mudrock of Middleton Fm.
244	S32° 42' 15.5" E25° 21' 31.3"	Spaarwater 103. Masotcheni Fm alluvial and colluvial deposits overlying channel sandstones of the Middleton Fm, exposed near the bed of a sizeable river (Doornrivier). Sandstones cross-bedded, locally undulose bed tops, channels clearly erosive based, cutting down markedly into hackly-weathering grey-green mudrocks with well-rounded, dark grey, cobble-sized palaeocalcrete concretions (freshly-broken surfaces within concretion grey, micritic, without sulphide odour), thin crevasse-splay sandstones.
245	S32° 42' 15.6" E25° 21' 33.1"	Spaarwater 103. Extensive exposure of undulose-topped, parallel-jointed major channel sandstone body of Middleton Fm in bed of Doornrivier (Undulations are probably tectonic rather than preserved bedforms). Close to river banks Karoo bedrocks and orange-brown, gravelly to sandy Masotcheni Fm deposits are overlain by greyish younger alluvium (probably Holocene in age).
246	S32° 42' 08.3" E25° 21' 14.5"	Spaarwater 103. Large (*c*. 30 cm wide), isolated, convex-downward sandstone body weathering out of thick package of weathered Middleton Fm mudrocks – probably a vertebrate burrow cast with infill of blocky-weathering sandstone containing reworked grey mudflakes (*cf* clear examples seen in Middleton Fm on outskirts of Somerset East) (*Proposed Field Rating IIIB Local Resource. Site lies within powerline corridor alternative but direct impacts in stream gulley unlikely. If this powerline corridor is chosen, site is best avoided (i.e. no disturbance or new infrastructure either side of existing farm track near fossil sites). Failing that, mitigation through pre-construction collection and recording by a specialist palaeontologist is acceptable*). Surface scatter of flaked stone artefacts (*e.g.* well-crafted MSA hornfels blades and points).
247	S32° 41' 35.0" E25° 21' 27.3"	Spaarwater 103. Views across NE portion of study area showing low relief (general slope to E), pervasive cover of pale brown soils and scattered sandstone surface gravels. View to south shows higher ground with series of low, east-facing scarps and fairly flat summits.
248	S32° 41' 25.7" E25° 21' 39.0"	Spaarwater 103, extensive bedrock exposures on gullied hillslopes just south of R63 and east of Soldaatkop.NE-flowing shallow stream gulley exposing grey-

		green mudrocks of the Middleton Fm. Crevasse-splay sandstone palaeosurfaces with small-scale wave rippled tops (playa lake), occasional narrow, subparallel linear grooves (probably tool marks, possibly biogenic). Thin bioturbated sandstone bed top with possible meniscate back-filled burrows (*cf Scoyenia*) and reedy plant stem casts – perhaps deposited on the margins of a swamp or pond (*Proposed Field Rating IIIC Local Resource. Site lies outside project footprint. No mitigation required*).
249	S32° 41' 41.3" E25° 22' 04.0"	Rietfontein 102. Small gullied hillslope exposure of weathered Middleton Fm mudrocks.
250	S32° 41' 56.7" E25° 21' 52.3"	Rietfontein 102. Hilltop views across northern and central part of WEF project area. Rollling grassy uplands with a few scattered thorn trees, sandy soils and domical termitaria, sparse to concentrated angular sandstone surface gravels, neglibible bedrock exposure, gullied orange-brown Masotcheni Fm deposits along major drainage lines.
252	S32° 42' 06.9" E25° 21' 51.0"	Rietfontein 102. Shallow upstream section of major, ESE-directed erosion gulley providing extensive exposure of grey-green Middleton Fm mudrocks. Sparse sizeable (sev. dm across) rusty-brown ferruginous calcrete concretions, some of which contain fossil bone (*e.g.* partial skull of medium-sized dicynodont – probably *Aulaceophalodon*, indeterminate bone fragments) (*Proposed Field Rating IIIB Local Resource. Site lies within powerline corridor alternative and close to existing farm track. If this powerline corridor is chosen, site is best avoided (i.e. no disturbance or new infrastructure either side of existing farm track near fossil sites). Failing that, mitigation through pre-construction excavation and recording by specialist palaeontologist is acceptable)*. Also abundant smaller pale grey-weathering pedogenic calcrete nodules.
253	S32° 42' 07.4" E25° 21' 51.2"	Rietfontein 102. Portion of short, wide limb bone preserved within a ferruginous calcrete concretion embedded in mudrock, Middleton Fm (*Proposed Field Rating IIIB Local Resource. Site lies within powerline corridor alternative and close to existing farm track. If this powerline corridor is chosen, site is best avoided (i.e. no disturbance or new infrastructure either side of existing farm track near fossil sites). Failing that, mitigation through pre-construction excavation and recording by specialist palaeontologist is acceptable)*.
254	S32° 42' 10.0" E25° 21' 56.4"	Rietfontein 102. Gulley exposures of incipiently calcretised Masotcheni Fm. Good sections through thick colluvial and soil profile with basal angular to subrounded sandstone gravels, horizons of small calcrete glaebules. Thin, pale-weathering crevasse-splay sandstones within mudrock-dominated Middleton Fm.
256	S32° 42' 12.1" E25° 22' 00.8"	Rietfontein 102. Widening of gulley with extensive exposure of gullied, orange-brown Masotcheni Fm, mainly resting on resistant sandstone bedrock (*e.g.* major channel sandstone or crevasse splay sandstone. Masotcheni Fm succession with basal gravels, gritty massive fine sands, often calcretised, with better-consolidated horizon at top forming prominent bench, darker brown younger soils. Current ripple cross-laminated bed top of channel sandstone. Isolated curved sandstone body weathering out of mudrock might be a vertebrate burrow cast (requires confirmation) (*Proposed Field Rating IIIB. Site lies outside project footprint. No mitigation is required*).
257	S32° 42' 06.5" E25° 21' 48.5"	Rietfontein 102. Shallow gullies eroded into Middleton Fm grey-green, blue-green and mottled purple-brown to grey-green mudrocks with abundant weathered-out, cobble-sized ferruginous calcrete concretions from pedogenic horizons, some of which potentially contain vertebrate fossils. Some examples show septarian (diagenetic shrinkage) cracking. Suggest occurrence of semi-arid intervals during history of Middleton Fm.
258	S32° 42' 12.0" E25° 21' 49.4"	Rietfontein 102. Shallow gullies eroded into Middleton Fm grey green mudrocks. Cobble-sized, ferruginous pedogenic calcrete concretions with indeterminate, suncracked or weathered (pre-burial) fossil bone (*Proposed Field Rating IIIB Local Resource. Site lies within powerline corridor alternative and close to existing farm track. If this powerline corridor is chosen, site is best avoided (i.e. no disturbance or new infrastructure either side of existing farm track near fossil sites). Failing that, mitigation through pre-construction excavation and recording by palaeontological specialist is acceptable)*.
259	S32° 42' 23.0" E25° 21' 47.6"	Rietfontein 102. Views southwards down into sizeable river valley showing thick development of orange brown alluvium / colluvium of Pleistocene Masotcheni Fm with typical *donga* erosion pattern. Locally overlain by greyish younger alluvium.

260	S32° 42' 18.7" E25° 20' 57.8"	Spaarwater 103. Views down and along west-facing Camdeboo Escarpment, densely vegetated for the most part but with thin, prominent-weathering channel sandstones.
261	S32° 42' 20.5" E25° 20' 52.7"	Spaarwater 103. Small gullied exposure of Middleton Fm grey-green and subordinate purple-brown mudrocks close to escarpment edge.
262	S32° 42' 40.8" E25° 19' 53.3"	Spaarwater 103. Viewpoint near wind mast towards Groot-Bruintjieshoogte Mountains to the north, showing regional stratigraphy (Middleton Fm, package of closely-spaced sandstones of Oudeberg Mb & overlying mudrock-dominated Daggaboersnek Mb of Balfour Fm, Karoo dolerite sill *plus* adjacent baked Karoo sediments forming cliff). WEF study area here (east of W-facing Camdeboo Escarpment) is fairly flat-lying in the west and then slopes gently to the east.
263	S32° 42' 45.6" E25° 19' 46.2"	Coetzees Fontein 104 / Spaarwater 103 boundary fence, near wind mast. Views southwards into gently hilly / rolling plateau terrain with very limited obvious bedrock exposure. Patinated hornfels artefacts in surface gravels near wind mast.
264	S32° 42' 49.2" E25° 21' 34.8"	Spaarwater 103. Long stream section with Middleton Fm weathered sandstone and mudrocks exposed along bed and banks, overlain by Masotcheni colluvial / alluvial gravels (often ferruginised, may form semi-consolidated breccia lenses), calcretised sands and younger soils, large domical termitaria developed within darker, younger soils.
265	S32° 43' 08.1" E25° 21' 49.9"	Rietfontein 102. Stream bank exposures of hackly, dark grey (organic-rich?) Middleton Fm mudrocks and fine-grained wackes building several thin, upward-fining packages). Khaki-hued partings within otherwise massive mudrocks yield common, bedding-parallel, longitudinally-striated, segmented stem compression moulds of sizeable sphenophytes (horsetail ferns) up to 2 cm wide (*Proposed Field Rating IIIB Local Resource. Site lies outside project footprint. No mitigation required*). Probable *vlei* or swamp facies around playa lake on Beaufort Group floodplain.
266	S32° 43' 20.0" E25° 22' 38.9"	Rietfontein 102. Shallow gullied hillslope exposure of Middleton Fm grey-blue mudrocks with sparse sandstone surface gravels.
267	S32° 43' 15.4" E25° 22' 49.1"	Rietfontein 102. Shallow gullied hillslope exposure of Middleton Fm grey-blue to grey-green mudrocks with sparse, small pedocrete nodules.
268	S32° 44' 43.8" E25° 22' 02.5"	Doorn Rivier 105. View of SW-dipping Middleton Fm channel sandstones WNW of Doornrivier farmstead. Grassy, flat-topped *koppies* to N and S capped by major dolerite intrusion. Dipping conformable sill (columnar-jointed) seen at waterfall in *kloof* to west of farmstead.
269	S32° 44' 45.2" E25° 22' 04.5"	Doorn Rivier 105. Numerous blocks of greyish, vuggy, slaggy vitrified dung near main abandoned farmhouse. Source unknown, so of limited research value (*Proposed Field Rating IIIC Local Resource. No mitigation required*).
270	S32° 44' 38.3" E25° 21' 59.2"	Doorn Rivier 105. Steep hillslope exposure of grey-green and minor purple-brown Middleton Fm mudrocks beneath channel sandstone, *c*. 250 m NW of farmstead. Pedogenic calcrete horizons, doleritic scree. Ill-defined fine-grained sandstones with transitional bases and tops (suggest swampy conditions on distal floodplain).
271	S32° 44' 06.6" E25° 22' 10.5"	Doorn Rivier 105. Extensive continuous strike exposure of Middleton Fm grey-green mudrocks and fine-grained channel sandstones, crevasse splays on stepped footslopes on *koppie* NNE of Doornrivier homestead. Subtle upward coarsening sequences from grey-green siltstone to fine "lumpy-weathering" sandstone to medium-grained channel sandstone – possibly progradation into a lake or interdistributary bay on the distal floodplain. Rubbly angular sandstone colluvium (scree). Mudrocks rich in large (up to several dm in diameter), sphaeroidal to irregular, dark brown, ferruginous calcareous nodules with dark grey interior (also suggest high water tables)
272	S32° 44' 06.4" E25° 22' 14.6"	Doorn Rivier 105. Middleton Fm with horizon of dark rusty-brown, closely-packed, ferruginous calcareous concretions. Possible sandstone load casts.
273	S32° 44' 10.8" E25° 22' 08.0"	Doorn Rivier 105. Riverbank section through *c*. 3 m basal gravelly and overlying pale brown sandy Holocene alluvium. Alluvial gravels dominated by anguler to rounded blocks and boulders of sandstone and dolerite.
274	S32° 44' 04.8" E25° 21' 52.7"	Doorn Rivier 105. Extensive exposures of orange-brown Masotcheni Fm on valley floor, *c*. 1.3 km NNW of farmstead. Downwasted surface gravels include abundant associated stone artefacts incl. LSA grindstones, microliths (hornfels, quartzite), possible graves. Rubbly younger sandstone colluvial gravels, darker alluvial soils and occasional incised channel infill gravels on top of Masotcheni succession.

275	S32° 44' 04.2" E25° 21' 52.1"	Lower succession of Masotcheni Fm gently dipping towards valley floor, well-consolidated and clearly-bedded with veins of calcrete, sparse embedded larger clasts.
276	S32° 44' 03.2" E25° 21' 54.3"	Doorn Rivier 105. Possible massive gritty to sandy debris flow facies within Masotcheni Fm.
281	S32° 43' 31.0" E25° 21' 07.1"	Doorn Rivier 105. Gullied hillslope exposure of grey-green and purple-brown Middleton Fm bedrocks *plus* overlying orange-brown Masotcheni Fm.
282	S32° 43' 24.3" E25° 21' 15.1"	Doorn Rivier 105. Long riverine cliff exposure of dark blue-grey and minor purple-brown, tabular-bedded to massive Middleton Fm mudrocks with sparse ferruginous calcrete pedocrete nodules / lenses, m-scale fining-up packages, crevasse-splay sandstones. Other sandstones are fine-grained wackes, Thick mudrock-dominated succession is capped by thin (single-storey), erosive-based, cleaner-washed channel sandstone body.
283	S32° 43' 29.0" E25° 21' 13.3"	Doorn Rivier 105. Erosion gulley exposures of sandy Masotcheni Fm. Embedded MSA blades within massive gritty, calcretised sandstones of lower Masotcheni succession, *Unless reworked*, they suggest a Pleistocene age for these older alluvial / colluvial deposits (also supported by high degree of calcretisation, with abundant small calcrete glaebules). One blade possible of pale yellowish-brown speckled tuff / tuffite.
284	S32° 43' 36.9" E25° 21' 34.9"	Doorn Rivier 105. Stream valley cut through major dolerite intrusion. Slopes mantled with colluvium of boulder-size, subrounded, rusty-brown, speckled dolerite corestones (no desert varnish here) and lateritic soils
285	S32° 44' 51.8" E25° 21' 22.1"	Doorn Rivier 105. Gently-dipping, dark mudrocks of Middleton Fm exposed in stream bed and banks *c*. 1 km west of farmstead. Small-scale wave ripples.
286	S32° 44' 24.4" E25° 20' 34.9"	Doorn Rivier 105. Viewpoint over central part of WEF study area – gently sloping to level grassy uplands, sparse to pervasive sandstone surface gravels, very limited bedrock exposure.
287	S32° 43' 35.6" E25° 21' 12.1"	Doorn Rivier 105. Shallow hillslope and gulley exposure of Middleton Fm mudrocks, dark fine-grained wackes.
288	S32° 43' 34.6" E25° 21' 22.3"	Doorn Rivier 105. Sandstone palaeosurfaces with small-scale wave ripples, sandstone casts of reedy plant stems (*Proposed Field Rating IIIC Local Resource. Lies outside project footprint. No mitigation required*).
289	S32° 45' 45.1" E25° 21' 57.2"	Doorn Rivier 105. Viewpoint across WEF study area – rolling grassy uplands with sparse sandstone gravels, trees mainly along water courses. Views N to Groot-Bruintjieshoogte Mountains, SW towards uplands of Balfour Fm on Highlands 36. Zone of small trees and greener grass across distant slopes probably marks dolerite sill.
290	S32° 46' 05.7" E25° 22' 17.9"	Doorn Rivier 105. Small hillslope exposure of hackly, grey-green Middleton Fm mudrocks, sandstone colluvial gravels, sparse ferruginous calcrete concretions *in situ*.
291	S32° 46' 01.8" E25° 23' 00.2"	Doorn Rivier 105. Hillslope exposure of blue-grey Middleton Fm mudrocks with large, sphaeroidal ferruginous carbonate concretions. Well-jointed, blocky-weathering channel thin sandstone body. Upward-fining packages within mudrocks impart a stepped weathering profile,
292	S32° 45' 30.7" E25° 22' 41.2"	Doorn Rivier 105. Extensive *donga*-eroded outcrop of Masotcheni Fm basal gravels and sand exposed in stream valley, overlain by darker brown younger alluvium and soils. Lenses of rubbly coarse alluvium (or debris flows) at lower elevations in valley, close to modern stream bed.
293	S32° 46' 11.4" E25° 21' 59.8"	Doorn Rivier 105. Incised, *donga*-eroded Masotcheni Fm lining water course for some distance.
294	S32° 45' 44.5" E25° 20' 34.1"	Doorn Rivier 105. View down steep, densely-vegetated, deeply-incised western escarpment.
295	S32° 45' 38.4" E25° 20' 30.5"	Doorn Rivier 105. Low rounded exposures, exfoliating corestones of dolerite – part fo major sill.
296	S32° 45' 11.8" E25° 20' 01.7"	Coetzees Fontein 104. Views down western escarpment – v. little bedrock exposure. Good zigzag track down into valley.
297	S32° 44' 21.9" E25° 19' 45.8"	Coetzees Fontein 104. Network of shallow gullies exposing Middleton Fm bedrocks – including extensive (otherwise rare) bedding plane exposures - close to western escarpment edge. Masotcheni Fm overlying current ripple-topped channel sandstone on lower valley slopes. Succession on upper hillslopes more weathered. Here are thin-bedded mudrocks with large ferruginous carbonate concretions as well as distinctive mudflake breccio-conglomerate facies forming 30 cm- to several m-thick beds (possibly deposited as a slurry, *i.e.* debris flow). Flakes *c*. 1 cm across and bedding parallel. Thin crevasse-splay sandstone

		towards top of exposed Middleton Fm succession.
298	S32° 44' 17.2" E25° 19' 44.8"	Coetzees Fontein 104. Small (*c*. 6 cm wide), crushed skull and partial postcrania (probably dicynodont therapsid) embedded *in situ* within hackly grey mudrocks of Middleton Fm (*Proposed Field Rating IIIB Local Resource. Site lies outside project footprint. No mitigation required*).
299	S32° 44' 16.4" E25° 19' 43.8"	Coetzees Fontein 104. *Possible* vertebrate burrow cast (c. 17 cm wide) embedded in hackly mudrock of Middleton Fm (requires confirmation) (*Proposed Field Rating IIIB Local Resource. Site lies outside project footprint. No mitigation required*).
301	S32° 44' 25.7" E25° 19' 42.9"	Coetzees Fontein 104. Interbedded dark grey, hackly mudrocks and crevasse-splay sandstones of Middleton Fm exposed along valley floor. Several *possible* small (*c*. 10 cm wide), cylindrical, dark sandstone burrow casts but these require confirmation – may well be dubiofossils (*Proposed Field Rating IIIB Local Resource. Site lies outside project footprint. No mitigation required*). Middleton rocks overlain by gravelly to sandy Masotcheni Fm with occasional outsized blocky sandstone clasts.
302	S32° 44' 25.3" E25° 19' 32.3"	Coetzees Fontein 104. Views down steep western escarpment – well-vegetated with little bedrock exposure apart from well-spaced, thin channel sandstones.
303	S32° 47' 25.2" E25° 21' 58.3"	Highlands 361. Major dolerite intrusion with clusters of large, subrounded corestones. Hornfels stone artefacts locally common.
306	S32° 47' 20.4" E25° 21' 46.9"	Highlands 361. Zone of large, well-rounded, coarse-grained dolerite corestones along outcrop of major dolerite sill. Sandstone / quartzite, hornfels and dolerite surface gravels.
307	S32° 47' 20.3" E25° 21' 39.5"	Highlands 361. Viewpoint towards southern part of WEF project area. Areas underlain by dolerite show slightly reddish hues (lateritic soils).
308	S32° 47' 20.1" E25° 20' 52.9"	Highlands 361. Hillcrest underlain by scabby-weathering, lichen-coated dolerite. Locally Balfour Fm (Oudeberg Mb) sandstones baked to blocky-weathering, well-jointed pale quartzite.
309	S32° 48' 14.5" E25° 20' 34.2"	Highlands 361. Viewpoint near escarpment, Round *koppie* to the south capped by Oudeberg Mb sandstones and dolerite. No mudrock exposures except in farm dam walls.
310	S32° 48' 42.9" E25° 21' 00.9"	Highlands 361. Craggy hillslopes on E side of rounded *koppie* built of pale buff to greyish, mottled, thick-bedded, massive channel sandstones of Oudeberg Mb (basal Balfour Fm). Superposed channel sandstones build stepped slopes. Very limited, weathered, hackly grey-green siltstone exposure (stream gully). Massive or with low angle trough cross-bedding as well as horizontal lamination (thin tabular beds). Speckled appearance of sandstones may be due to baking by nearby dolerite intrusion (*plus* sandstones are probably feldspathic). Sandstone surface gravels (often subrounded) but no weathered-out fossil wood seen.
311	S32° 48' 43.9" E25° 20' 54.8"	Highlands 361. Long overhang beneath v. thick-bedded Oudeberg Mb sandstone excavated along siltstone horizon. Relict infill of orange-brown sandy sediment and suspended sandstone gravels resembling Masotcheni Fm. Exposures of weathered, hackly, yellowish- to grey-green siltstone along strike, with thin-bedded to laminated sandstone beneath, gullied erosive sole of thick channel sandstone above.
312	S32° 48' 21.6" E25° 19' 34.1"	Highlands 361. Steep, w-facing escarpment slopes well-vegetated, with occasional, surprisingly extensive gulley and hillslope exposures of hackly to crumbly, grey-green mudrocks interbedded with greenish, mottled sandstones (*probably* all within the uppermost Middleton Fm). Sandstone float blocks showing finely-spaced heavy mineral lamination.
313	S32° 47' 23.4" E25° 20' 13.2"	De Mullers Kraal 145. View N across *kloof* of major cliff of columnar-jointed dolerite and baked Oudeberg Mb sandstone along edge of dissected escarpment west of Mulderskraal farmstead.
314	S32° 47' 15.3" E25° 21' 12.5"	Highlands 361. Masotcheni Fm gullied exposures in valley. Flaggy baked sandstone scree on hillslopes.
316	S32° 42' 17.6" E25° 22' 41.7"	Rietfontein 102. Good riverine exposures of Middleton Fm mudrocks and channel sandstones overlain by thick Masotcheni Fm sandstones. Younger, less consolidated sandy alluvium is greyish and, above that, pale brown, locally with gravel lenses.
317	S32° 42' 17.5" E25° 22' 46.3"	Rietfontein 102. Extensive river bed exposures of small-scale wave-rippled, well-jointed Middleton Fm sandstones, with straight- to sinuous-crested rippling at several successive horizons (probably persistent shallow playa lake facies). Ripple pattern locally disrupted by discrete bands of contrasting ripple orientation.

<table>
<tr><td colspan="3">APPENDIX 2: CHANCE FOSSIL FINDS PROCEDURE: Highlands Wind Energy Facility and Grid Connection, Somerset East</td></tr>
<tr><td>Province & region:</td><td colspan="2">EASTERN CAPE, Somerset East District</td></tr>
<tr><td>Responsible Heritage Resources Authority</td><td colspan="2">ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; smokhanya@ecphra.org.za)</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Permian Middleton and Balfour Formations (Lower Beaufort Group), Pleistocene – Holocene Masotcheni Formation</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Fossil bones, teeth, burrows and trackways of Permian vertebrates, petrified wood and other plant material. Fossil teeth, bones and horncores of mammals in Pleistocene colluvial and alluvial deposits.</td></tr>
<tr><td rowspan="5">ECO protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
Context – describe position of fossils within stratigraphy (rock layering), depth below surface
Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation
Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Authority for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
Photograph fossils against a plain, level background, with scale
Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Authority, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Authority</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Authority. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Authority minimum standards.</td></tr>
</table>

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/ or 12/9/11/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

HIGHLANDS WIND ENERGY FACILITIES & ASSOCIATED GRID CONNECTION POWERLINES

Specialist:	Dr John Edward Almond		
Contact person:	As above		
Postal address:	PO Box 12410 Mill Street, CAPE TOWN		
Postal code:	8010	Cell:	N/A
Telephone:	021 462 3622	Fax:	N/A
E-mail:	almond@universe.co.za		
Professional affiliation(s) (if any)	Palaeontological Society of SA, Geological Society of SA, Association of Professional Heritage Practitioners (APHP)		

Project Consultant:	Anja Albertyn		
Contact person:	As above		
Postal address:	Office 220 Cube Workspace, Long Street, CAPE TOWN		
Postal code:	8001	Cell:	N/A
Telephone:	+27 (0) 21 412 1533	Fax:	N/A
E-mail:	AnjaA@arcusconsulting.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, **~~Dr John Edward Almond~~**, ~~declare that --~~ General

declaration:

I act as the independent specialist in this application;
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I declare that there are no circumstances that may compromise my objectivity in performing such work;
I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
I will comply with the Act, Regulations and all other applicable legislation;
I have no, and will not engage in, conflicting interests in the undertaking of the activity;
I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
all the particulars furnished by me in this form are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: John E Almond

Name of company (if applicable): **NATURA VIVA CC**

Date: 2 July 2018

John E Almond

I certify that the above statement was made by me and that the deponent has acknowledged that he/she knows and understands the contents of this statement. This statement was sworn to/affirmed before me and deponent's signature/mark/thumbprint was placed thereon in my presence.

te CAPE TOWN op 2018-07-02 om 21:45
at on at

(HANDTEKENING) KOMMISSARIS VAN EDE
(SIGNATURE) COMMISSIONER OF OATHS

RICHARD MAXWELL

VOLLE VOORNAME EN VAN IN DRUKSKRIF
FULL FIRST NAMES AND SURNAME IN BLOCK LETTERS

CAPE TOWN CENTRAL SAPS

BESIGHEIDSADRES (STRAATADRES)
BUSINESS ADDRESS (STREET ADDRESS)

24 BUITENKANT STREET

SONSKYN

RANK
SA POLISIEDIENS
SA POLICE SERVICE

SUID-AFRIKAANSE POLISIEDIENS
STASIE KOMMISSARIS
KAAPSTAD
02 JUL 2018
CAPE TOWN
STATION COMMANDER
SOUTH AFRICAN POLICE SERVICE