PROPOSED HOOGLAND WIND FARMS AND GRID CONNECTION PROJECT

NORTHERN CLUSTER: HOOGLAND 1 WIND FARM, HOOGLAND 2 WIND FARM AND ASSOCIATED HOOGLAND NORTHERN GRID CONNECTION, WESTERN CAPE PROVINCE

Palaeontological Heritage

DEFF Reference: TBA
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EXECUTIVE SUMMARY

The company Red Cap Energy (Pty) Ltd and its affiliate companies is proposing to develop two wind energy facilities, the Hoogland 1 Wind Farm and Hoogland 2 Wind Farm, on adjoining sites in the Upper Karoo region south of Loxton, located in the Beaufort West Local Municipality (Central Karoo District), Western Cape Province. Each wind farm would have a targeted nameplate capacity of up to a maximum of 420 MW and would involve the construction of no more than 60 turbines. The Hoogland Wind Farms will be connected *via* a 132 kV overhead power line to the Nuweveld Collector Substation on Red Cap's adjacent Nuweveld Wind Farms Project. Stream crossings in the Western and Northern Cape are assessed in a separate PIA report (Appendix 5) as requested by SAHRA (CaseID: 18203, Interim Comment 10 June 2022).

The combined project area for the Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection is underlain by continental sediments of the Lower Beaufort Group (Karoo Supergroup) of Middle to Late Permian age. Few fossil sites have been identified here previously. A limited number of new fossil sites were recorded during a ten day reconnaissance-level palaeontological heritage survey of the combined project areas (See Appendix 2 for details and satellite mapping). They include several skulls and post-cranial skeletal remains of tetrapods - mainly small-bodied therapsids such as dicynodonts and therocephalians, numerous tetrapod burrow casts, as well as low diversity trace fossil assemblages but no unequivocal fossil wood and only fragmentary plant material.

Based on the new field data as well as desktop research it is concluded that: well-preserved fossils of scientific and conservation interest are remarkably rare within the project area as a whole. This is attributed to (a) poor levels of bedrock exposure associated with generally low relief and pervasive cover by largely unfossiliferous superficial sediments; (b) extensive dolerite intrusion which has "sterilized" large volumes of potentially fossiliferous bedrocks through thermal metamorphism, leaching and secondary mineralisation, while the large dolerite outcrop areas in the uplands are completely fossil-free; (c) highly impoverished fossil biotas within the upper Abrahamskraal Formation to lowermost Teekloof Formation (Poortjie Member) stratigraphic interval that are associated with the catastrophic end Middle Permian Mass Extinction Event of ~260 Ma.

Most of the combined wind farm and grid connection project area has been provisionally rated as of Very High Palaeosensitivity (SAHRIS website, DFFE Screening Tool) due to the rich Permian fossil assemblages frequently recorded from the Lower Beaufort Group in the Main Karoo Basin. This sensitivity rating is *contested* here. The great majority of the fossil sites recorded within the project area are of limited scientific or conservation value (low Heritage Provisional Field Rating) and in practice the majority of the project area is of Low Palaeosensitivity. However, the occurrence of sparse, small and largely unpredictable fossil sites of High Sensitivity cannot be entirely discounted.

For the construction phase the palaeontological heritage impact significance of each of the proposed Hoogland wind farm and grid connection projects, including all the component infrastructure listed in the project descriptions, is assessed as **Low (-ve)** without mitigation and **Very Low (-ve)** following mitigation. No significant further impacts are anticipated in the Operational and Decommissioning Phases. The impact significance of the No-Go Alternative computes as **Very Low (-ve)** but on balance this would probably have a *neutral* impact on palaeontological heritage. Anticipated cumulative impacts of the closely spaced Hoogland and Nuweveld renewable energy projects in the Upper Karoo region to the south of Loxton are assessed as **Medium (-ve)** without mitigation, falling to

Low (-ve) with full mitigation of all projects concerned. These levels of cumulative impact fall within acceptable limits.

In terms of palaeontological heritage there are no fatal flaws in the proposed Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection renewable energy projects and there are no objections to their authorisation.

None of the known fossil sites within the combined project area lies within or close to (≤ 20m) the proposed project footprints and no palaeontological mitigation is therefore required in their regard. Most additional, unrecorded fossil sites identified during the pre-construction or construction phase can be readily mitigated, if necessary, through a Chance Fossil Finds Protocol, as outlined in Appendix 4.

The final, authorised layouts of the Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection projects should be cross-checked against the available fossil database and other relevant resources (*e.g.* satellite imagery, geological maps) by a palaeontological specialist who should make recommendations for pre-construction phase mitigation, if any proves necessary. This might entail, for example, focused palaeontological walk-downs of selected, previously unsurveyed and potentially sensitive sectors of the project footprint, with judicious sampling or collection of threatened fossil material of scientific and / or conservation value. An approved Work Plan from Heritage Western Cape will be required by the specialist palaeontologist responsible for mitigation work.

These palaeontological mitigation measures, including the Chance Fossil Finds Protocol, should be incorporated into the EMPr for each of the Hoogland renewable energy projects.

NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) AND ENVIRONMENTAL IMPACT REGULATIONS, 2014 (AS AMENDED) - REQUIREMENTS FOR SPECIALIST REPORTS (APPENDIX 6)

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 1
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	p. v
c) an indication of the scope of, and the purpose for which, the report was prepared;	1
(cA) an indication of the quality and age of base data used for the specialist report;	2.3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	7.2 & 7.3
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	2.3
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	2.3
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;	7
g) an identification of any areas to be avoided, including buffers;	n/a
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Appendix 2
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	2.4
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 & 6
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, and where applicable, the closure plan;	9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	n/a
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	SAHRA Interim Comment Appendix 6
q) any other information requested by the competent authority.	
2) 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.	

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

PROPOSED HOOGLAND WIND FARMS: HOOGLAND 1 WIND FARM, HOOGLAND 2 WIND FARM & HOOGLAND NORTHERN GRID CONNECTION

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

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Physical address:
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Email: EIAAdmin@environment.gov.za

SPECIALIST INFORMATION

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B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100
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DECLARATION BY THE SPECIALIST

I, **Dr John Edward Almond**, declare that –

- 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

NATURA VIVA CC

Name of Company

22 June 2022

Date

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LIST OF ABBREVIATIONS

DFFE	Department of Forestry, Fisheries and the Environment
ECO	Environmental Control Officer
EMPr	Environmental Management Programme
ESO	Environmental Site Officer
Ma	Millions of years ago
PIA	Palaeontological Heritage Impact Assessment

1. INTRODUCTION

Dr John E. Almond has been appointed by SLR South Africa Consulting (Pty) Ltd, on behalf of Red Cap Energy (Pty) Ltd and their affiliate companies (Red Cap Hoogland 1 (Pty) Ltd, Red Cap Hoogland 2 (Pty) Ltd, Red Cap Hoogland 3 (Pty) Ltd and Red Cap Hoogland 4 (Pty) Ltd), hereafter referred to as "Red Cap", to undertake a combined desktop and field-based Palaeontological Heritage Assessment for the proposed construction of four wind farms and associated grid connection (together known as the Hoogland Projects) in an area located between Loxton and Beaufort West in the Western Cape Province (Figure 1-1). In addition, some road infrastructure (watercourse crossings) within both Northern Cape and Western Cape will also require upgrade as part of the projects. These crossings are assessed in a separate PIA report (Appendix 5) as requested by SAHRA (CaseID: 18203, Interim Comment 10 June 2022).

The Hoogland 1 Wind Farm and Hoogland 2 Wind Farm are located to the north, closer to Loxton, and form the Northern Cluster of wind farms which will share a grid connection, named the Hoogland Northern Grid Connection. Hoogland 3 Wind Farm and Hoogland 4 Wind Farm are located closer to Beaufort West and comprise the Southern Cluster which will similarly share a separate grid connection, named the Hoogland Southern Grid Connection. The two Grid Connections are each in the form of 132 kV overhead power lines and will connect the Hoogland Wind Farms to the Nuweveld Collector Substation on Red Cap's adjacent Nuweveld Wind Farms Project.

In terms of the EIA Regulations various aspects of the proposed development may have an impact on the environment and are considered to be listed activities. These activities require authorisation from the National Competent Authority (CA), namely the Department of Forestry, Fisheries and the Environment (DFFE), prior to the commencement thereof. Specialist studies have been commissioned to verify the sensitivity and assess the impacts of the wind farms under the Gazetted specialist protocols (GN R 320 and GN R 1150 of 2020).

The scope of this report is the Hoogland 1 Wind Farm and Hoogland 2 Wind Farm (the Northern Wind Farm Cluster) and the associated Hoogland Northern Grid Connection. Even though these are three separate applications, given their very similar geological underpinning and hence palaeontological heritage resources, they will be considered in the same specialist report.

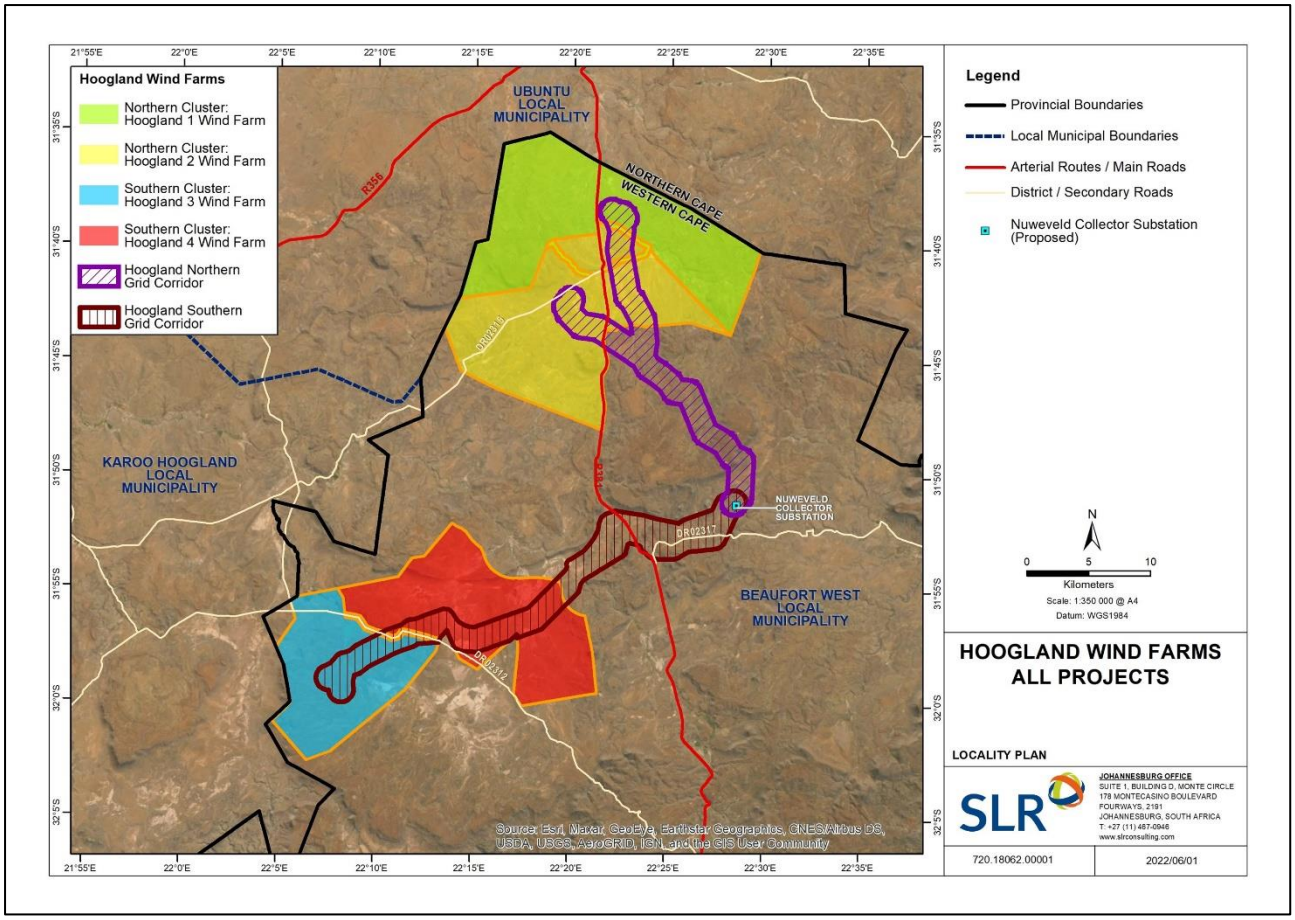

Figure 1-1: Regional context map for the Hoogland Wind Farm projects and associated grid connections in the Upper Karoo region of the Western and Northern Cape.

2. ASSESSMENT METHODOLOGY

2.1. Specialist Credentials

Please see Appendix 1 for a short CV for the present author.

2.2. Terms of Reference

The present combined desktop and field-based PIA report assesses potential impacts to palaeontological heritage resources that may result from the proposed Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and the associated Hoogland Northern Grid Connection. It will contribute to the over-arching Heritage Impact Assessments, coordinated by ASHA Consulting and SLR Consulting, as part of the Basic Assessment / Environmental Impact Assessment processes for these developments as well as to the relevant EMPrs.

2.3. Information sources and approach

This desktop and field-based palaeontological heritage study of the Hoogland Northern Wind Farm Cluster, and associated Hoogland Northern Grid Connection projects was based on the following information resources:

1. A detailed project outline, kmz files, screening report and maps provided by SLR Consulting;

2. A desktop review of:

(a) the relevant 1:50 000 scale topographic maps (3122CA Juriesfontein, 3122CB Slangfontein, 3122CC Vonkfontein and 3122CD Dunedin) as well as the 1:250 000 scale topographic map 3122 Victoria West,

(b) Google Earth© satellite imagery,

(c) published geological and palaeontological literature, including 1:250 000 geological maps (3122 Victoria West) and the relevant sheet explanations (Le Roux & Keyser 1988) as well as

(d) recent palaeontological heritage assessments (PIAs for the adjacent Red Cap Nuweveld projects, Hoogland 3 Wind Farm, Hoogland 4 Wind Farm and Hoogland Southern Grid Connection) in the Upper Karoo region near Loxton by the author (Almond 2020a-c, 2021, Almond 2022);

3. The author's field experience with the formations concerned and their palaeontological heritage (*cf* Almond & Pether 2008 and PIA reports listed in the References); and

4. A ten-day field assessment of the combined Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection project areas, including portions of all previously unsurveyed land parcels involved, by the author and an experienced field assistant (Ms Madelon Tusenius, *Natura Viva* cc), during the period 9-19 April as well as 14 May 2021. This study also makes reference to field data for sectors of the Northern Grid Connection corridor that overlap the project area of the Nuweveld Wind Farm cluster and that were previously assessed by Almond (2020a-c, 2021).

The season in which the site visit took place has no critical bearing on the palaeontological study.

Stream crossings in the Western and Northern Cape are assessed in a separate PIA report (Appendix 5) as requested by SAHRA (CaseID: 18203, Interim Comment 10 June 2022).

Study approach

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations, members *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 Western Cape have already been compiled by J. Almond and colleagues; *e.g.* Almond & Pether 2008) and are shown on the palaeosensitivity map on the SAHRIS (South African Heritage Resources Information System) website. Based on the new desktop and field data, the provisional palaeosensitivity mapping shown by the DFFE Screening Tool is addressed (Appendix 3). The likely impact of the 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. Consolidated as well as 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 occasional practice for palaeontologists responsible for palaeontological impact assessments to collect representative, well-localised (*e.g.* GPS and stratigraphic data) samples of fossil material during field assessment studies. In order to do so, an approved Work Plan from Heritage Western Cape (HWC) will be required by the specialist palaeontologist responsible for mitigation work. .

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 as much, or even far *more*, time examining road cuts and borrow pits close to, but outside, the study area / project footprint than within the study area / project footprint 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.

Given (1) the large project areas concerned with the Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection projects and (2) the generally limited bedrock exposure in this region of the Great Karoo, the palaeontological heritage field study largely entailed the examination of selected

potentially fossiliferous sites with good Beaufort Group mudrock exposure – especially along drainage lines as well as hillslopes and erosion gullies. Since previous field experience shows that in the lower part of the Beaufort Group outcrop area important fossil sites may also occur in association with crevasse splay and channel sandstones, a representative selection of such sites as well as good sections through Late Caenozoic alluvial deposits were also examined. It is emphasised that it is simply *not* practicable to record all, or even a major portion, of fossil sites within such a large area within the course of a few days' fieldwork, and that the occurrence of fossils at surface in the Great Karoo has a large element of unpredictability. Several fossil sites were discovered simply by chance. It is therefore inevitable that the recent site visit can only hope to locate a *representative subsample* of surface fossil sites present within the wind farm and grid connection project areas. The absence of recorded sites within an area does *not* therefore mean that palaeontologically significant material is not present there, either on or beneath the ground surface.

2.4. Assumptions and Limitations

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

- 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.

- 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.

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

- 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.

- 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:

- *underestimation* of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
- *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 combined Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection project area exposure of potentially fossiliferous sedimentary bedrocks is often very poor, especially in areas of low relief where it is highly constrained by extensive superficial deposits, as well as, to a lesser extent, by shrubby vegetation, and in uplands underpinned by large dolerite intrusions. The project area is very extensive (> 34 000 ha for the Northern Wind Farm Cluster, and >19 000 ha for the Grid Connection corridor), much of it with relatively few access roads. Unavoidably, only a small fraction of the entire project area could be surveyed on foot within the time available (*c*. 10 days).

Nevertheless, sufficient exposures of Karoo Supergroup bedrocks (including several of excellent quality) as well as sections through Late Caenozoic superficial deposits were examined during the course of the ten-day field study to assess the palaeontological heritage sensitivity of the main rock units represented within the combined Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection study area (See palaeontological data table in Appendix 2). Since parts of the grid connection project area lying outside the Hoogland 1 Wind Farm and Hoogland 2 Wind Farm have already been recently assessed by the author (Almond 2021a-c, 2021), these sectors are only treated at a desktop level in the present report *i.e.* no further field work was undertaken for these areas.

Comparatively few academic palaeontological studies or palaeontological impact assessments have been carried-out hitherto in this region of the Great Karoo, so any new data from impact studies here are of scientific interest. Confidence levels for this impact assessment are rated as *medium*, despite the unavoidable constraints of limited time and access in the project area.

3. LEGAL REQUIREMENTS AND GUIDELINES

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) and by Heritage Western Cape (2021).

4. PROJECT DESCRIPTION

4.1 Project Location

The proposed renewable energy projects are located in an area located between Loxton and Beaufort West in the Beaufort West Local Municipality (Central Karoo District) of the Western Cape Province (Figure 1-1).

Short project descriptions for the Hoogland 1 and Hoogland 2 Wind Farms and the Hoogland Northern Grid Connection as relevant to the PIA are included in Sections 4.2 to 4.3.

4.2 Wind farm components

Each wind farm requires several key components to facilitate the generation of electricity at a large scale. These include:

- Wind turbines;
- Roads;
- Underground cables and overhead high voltage power lines (up to 66 kV);
- Two substations (including an operations and maintenance area for control, operation, workshop, storage buildings / areas); and
- Two battery storage facilities in the vicinity of the substations.

Table 4-1 below summarizes these various wind farm components and their specifications, as well as a detailed breakdown of their impact footprints or sizes *per* wind farm. Temporary areas necessary for construction are also included. The location of these components in relation to each wind farm site is shown on Figure 4-1 and Figure 4-2.

Table 4-2 below summarizes the water course crossings in the Northern Cape with will be applied for within the Hoogland Northern Cluster EIA. The location of these crossings is shown on Figure 4-3 below. These crossings are assessed in a separate palaeontological report that is appended here (Appendix 5).

4.3. Site Layouts

Figure 4-1 and Figure 4-2 depict the site layout for Hoogland 1 Wind Farm and Hoogland 2 Wind Farm respectively. They differentiate between 'Roads and Cables' where cables run alongside proposed or existing roads, 'Off-road Cables' where cables will not run alongside proposed or existing roads, and the 'Internal Overhead Power Lines' where trenching is not possible and overhead cables must be spanned.

The site layout for each wind farm has been through various iterations during the Screening and Initial Design Phases. The current Pre-application layout makes provision for a number of potential turbine positions specific to each wind farm with associated infrastructure, as shown in the following figures.

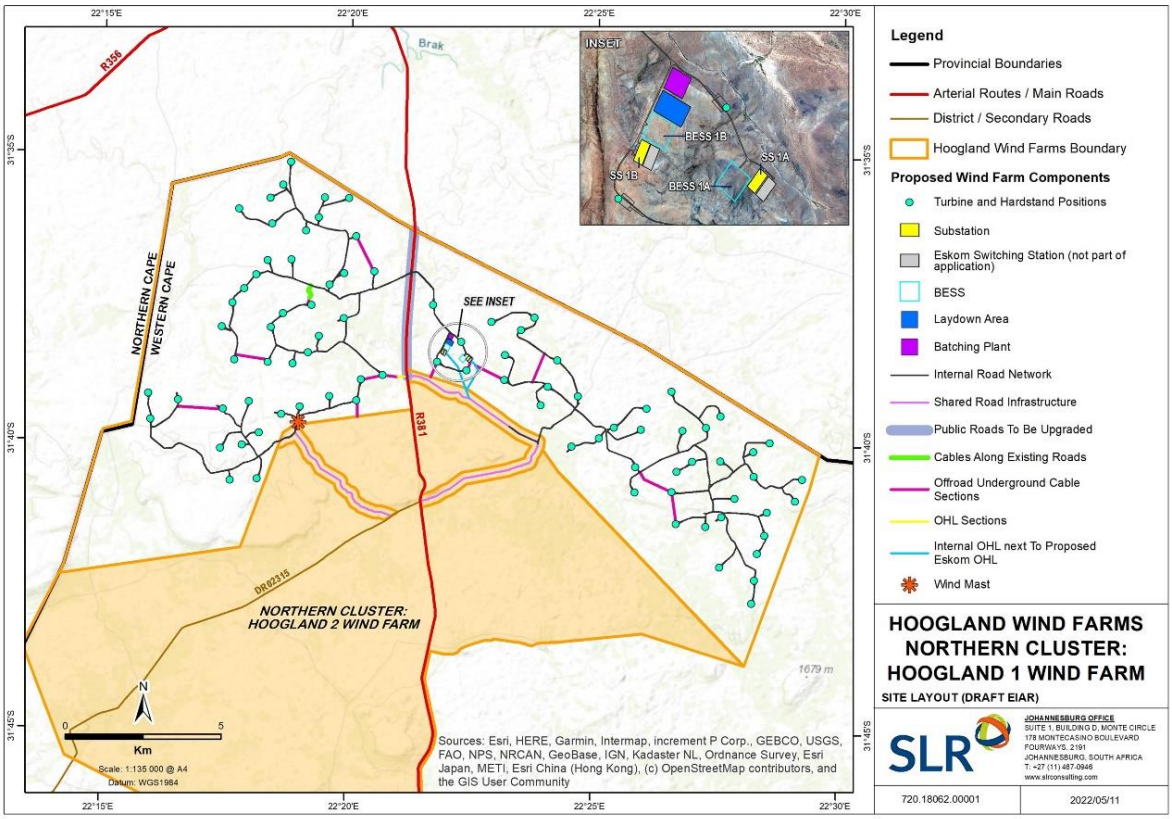

Figure 4-1: Proposed layout for Hoogland 1 Wind Farm.

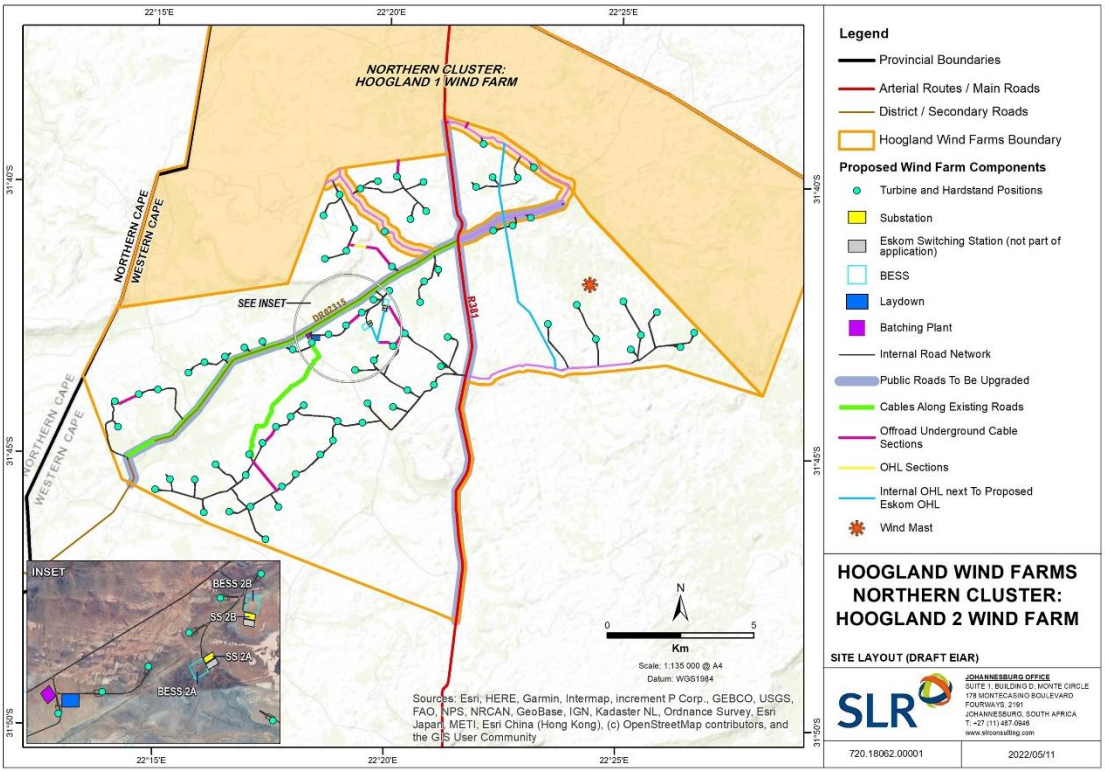

Figure 4-2: Proposed layout for Hoogland 2 Wind Farm.

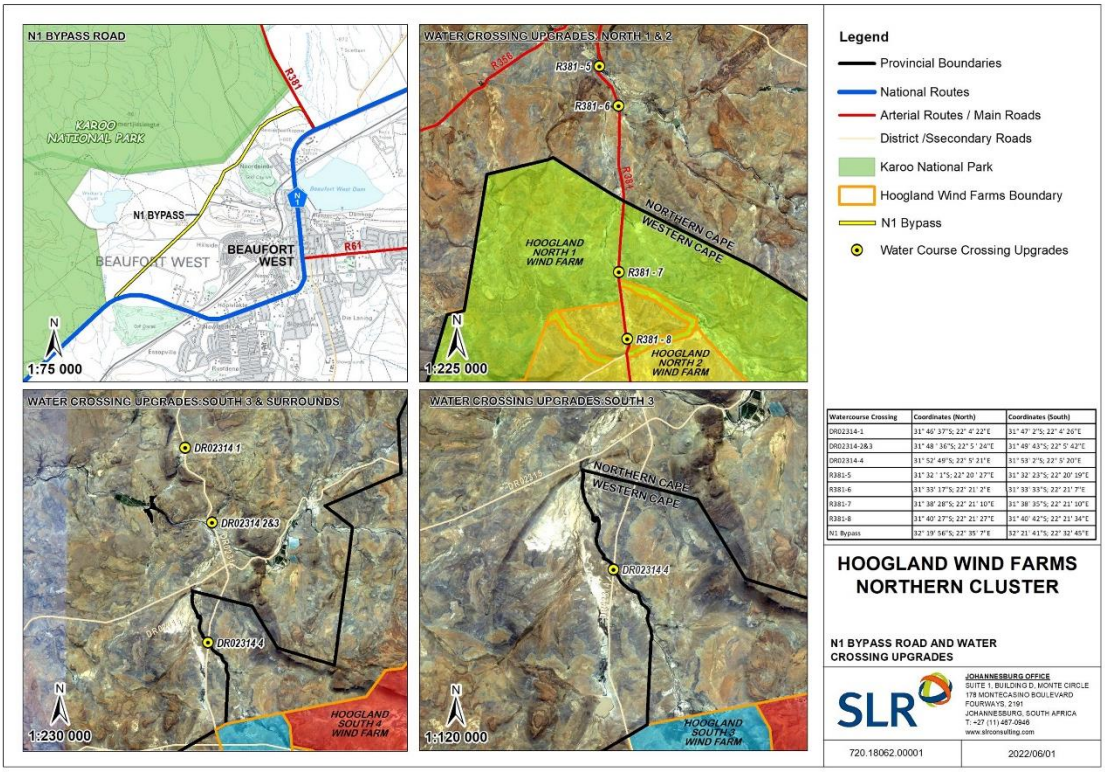

Figure 4-3: Hoogland 1 and 2 Wind Farms Application - Watercourse Crossing Upgrades (See also Table 4-3and Appendix 5 for a separate palaeontological heritage study of these portions of the WEF footprint)

Table 4-1: Summary of the components, specifications, and approximate areas of impact of each of the Hoogland Northern Cluster Wind Farms based on a maximum of 60 turbines*

Project Components	Description	Hoogland 1	Hoogland 2
Location	Central coordinates:	31°38'18.90"S, 22°18'0.44"E	31°43'16.68"S, 22°19'50.27"E
Access	For commuter traffic and some small loads, access from the south would be via Beaufort West via the N1 and R381 travelling between Beaufort West and Loxton. For abnormal loads the main access routes for each wind farm are as follows:	Through Loxton, south along the R381 towards HL01 and HL02	
Extent	The total area of the site being considered for developing each wind farm (including shared infrastructure sections where relevant):	16,772 ha	17,832ha
Number of wind turbines and generation capacity	Up to a maximum of 60 wind turbines per wind farm will be developed. The targeted nameplate generation capacity for each wind farm is up to a maximum of 420 MW.	60	60
	However, the number of turbines included in the layout for approval for each wind farm is as follows:	87	80
Wind turbine specifications	• Rotor diameter: 100 m to 195 m (50 m to 97.5 m blade / radius) • Hub height: 80 m to 150 m • Rotor top tip height: 130 m to 247.5 m (maximum based on 150 m hub + 97.5 m blade = 247.5 m) • Rotor bottom tip height: minimum of 20 m (and not lower). See Figure 3-1 below.	-	-
Turbine Foundations	Each turbine will have a circular foundation with a diameter of up to 35 m, alongside the 40 m hardstand (1,400 m^2). The permanent total footprint is as follows:	8.4 ha (permanent)	8.4 ha (permanent)
Turbine Hardstands and Laydown Areas	Each turbine will have a permanent crane pad of 80 m x 40 m placed adjacent to each turbine foundation. The total permanent footprints are as follows:	19.2 ha (permanent)	19.2 ha (permanent)
	An additional 20 m x 40 m of temporary hardstand area will also be required near each of the	31.2 ha (temporary)	31.2 ha (temporary)

Project Components	Description	Hoogland 1	Hoogland 2
	crane pads. Further, a blade laydown area of 104 m x 20 m and an additional embankment area (where necessary due to slopes) of approximately 104 m x 5 m will be required. A temporary crane boom assembly area of 120 x 15 m will also be accommodated. Temporary areas are up to a maximum of a maximum of 5,200 m^2 per turbine. The total temporary footprints per wind farm are as follows:		
Cabling	Turbines to be connected to on-site substation via up to 66 kV cables. Cables to be laid underground in trenches mainly adjacent to proposed wind farm roads (as part of the temporary impact of 'Site roads' below) but in some instances the cables will deviate from the road. Such sections of off-road cables amount to the following length and footprint:	10.7 km 6.4 ha (temporary)	7.6 km 4.6 ha (temporary)
	Where it has been possible, cables have been routed along existing local roads. Note that cables running next to public roads will not be able to run within the road reserve, but as close as possible to the road reserve in the adjacent private owned land. These have the following length and footprint:	0.5 km 03 ha (temporary)	18.8 km 11.3 ha (temporary)
Internal wind farm overhead power lines	In limited instances, overhead monopole lines will be used where burying is not possible due to technical, geological, environmental or topographical constraints. Up to 66 kV overhead power lines supported by 132 kV monopole style pylons of approx. 22 m high will be required, as well as tracks for access to the pylons. The total length of the line and the footprint of the pylons and tracks are as follows:	0.2 km 0.1ha (permanent)	0.5 km 0.3 ha (permanent)
	Where possible, to reduce areas of new impact, sections of overhead line have been routed next to proposed Eskom overhead lines. Such sections of overhead lines have the following additional length and footprint:	3.2 km 1.9 ha (permanent)	10.2 km 6.1 ha (permanent)
Site roads	The total road network for each wind farm* is as follows:	122.2 km	110.8 km
	Permanent roads will be 6 m wide and over above this may require side drains on one or both sides depending on the topography. Many roads will have underground cables running next to them.	*97.7 ha (permanent)	*88.7 ha (permanent)

Project Components	Description	Hoogland 1	Hoogland 2
	The permanent footprint of the road network for each wind farm is as follows:		
	An up to 15 m wide road corridor may be temporarily impacted during construction and rehabilitated to allow for a 6 m road surface after construction. The temporary footprint of the road network for each wind farm is as follows:	*110 ha (temporary)	*99.7 ha (temporary)
	This total road network also includes upgrades to sections of public roads, to the following extent:	4.7 km (permanent)	3.6 km (permanent)
	This total road network also includes shared road infrastructure with the other wind farm in the respective cluster:	16. 9 km (permanent)	16. 9 km (permanent)
	This total road network also includes shared road infrastructure with Nuweveld North and West Wind Farms as follows:	N/A	11.6 km (permanent)
Wind farm Substations	Each wind farm will have two 150 m x 75 m substation yards that will include an Operation and Maintenance (O&M) building, Substation building and a High Voltage Gantry. The area for the two substation yards per wind farm are as follows:	2.3 ha (permanent)	2.3 ha (permanent)
Battery energy storage system (BESS)	Each wind farm will also potentially have two ±3.5 ha areas for a battery energy storage system (BESS) which may be adjacent or slightly removed from each of the two substations depending on the local constraints. Each BESS may either be connected to the wind farm substation by an underground or overhead cable or may require its own substation which would be located within the BESS footprint and would be connected directly to the Eskom switching station via a short 132 kV overhead line.	7 ha (permanent)	7 ha (permanent)
Operations and maintenance (O&M) area	The O&M area will include all offices, stores, workshops and laydown area. The substation building will be housed in the substation yard.	Forms part of substation yard	Forms part of substation yard
Security	Security gate and hut to be installed at most entrances to each wind farm site (estimated as 4 entrances each at 20 m^2). No fencing around individual turbines, existing fencing shall remain around perimeter of	80 m^2	80 m^2

Project Components	Description	Hoogland 1	Hoogland 2
	properties. Temporary and permanent yard areas to be enclosed (with access control) with an up to 2.4 m high fence.		
Temporary areas required for the construction / decommissioning phase	Each wind farm will have the following temporary construction areas: • Temporary site camp/s areas of ±20,000 m^2 • Batching plant area of ±2,000 m^2 • General laydown area of ± 36,000 m^2 • Each wind farm will have a bunded fuel & lubricants storage facility at the site camp. Individual turbine temporary laydown areas including crane boom laydown areas, blade laydown areas and other potential temporary areas are detailed above under "turbine hardstands".	6 ha (temporary)	6 ha (temporary)
Shared offsite infrastructure: **N1 Bypass Road**	As part of the Nuweveld Wind Farms, a temporary bypass road is required on the N1 to avoid the town of Beaufort West with the major Wind Farm components. The road surface will be up to 6 m wide, with side drains, but a 12 m wide road corridor may be temporarily impacted during construction and rehabilitated once construction is complete. The length of the temporary road will be about 5.6 km of which about 2.5 km is along an existing track. It is planned that this road will also be used by the Hoogland Wind Farms and this is why it is shared infrastructure between the Nuweveld projects and these projects.	6.8 ha (shared, temporary)	6.8 ha (shared, temporary)
Other offsite shared infrastructure	Stream crossings upgrades along the R381 to the north of the project area and along the DR02314 to the north-west of the project area are required.	4.4 ha (shared, permanent) 5 ha (shared, temporary)	4.4 ha (shared, permanent) 5 ha (shared, temporary)
Total disturbance footprint		165.7 ha temporary and 141 ha permanent	164.6 ha temporary and 136.3 ha permanent

*Note these areas represent more than will be impacted given the road values are based on all the turbines shown in the layout for each individual wind farm being constructed wherein reality only 60 of these turbines will be developed per wind farm.

Table 4-2: Hoogland 1 and 2 Wind Farms Application - Watercourse Crossing Upgrades.

Watercourse Crossing (No. & road)	Current Situation	Province and Municipality	Coordinates (North)	Coordinates (South)	Road reserve Landowners	Photograph
1. DR02314	Drift	Northern Cape, Namakwa DM, Karoo Hoogland LM	31° 46' 37" 22° 4' 22"	31° 47' 2" 22° 4' 26"	Northern Cape Government: Department of Roads and Public Works	
2 & 3. DR02314	Low water cement drift with culverts	Northern Cape, Namakwa DM, Karoo Hoogland LM	31° 48 ' 36" 22° 5 ' 24"	31° 49' 43" 22° 5' 42"	Northern Cape Government: Department of Roads and Public Works	 
4. DR02314	Low water cement drift with blocked culverts	Northern Cape, Namakwa DM, Karoo Hoogland LM; and Western Cape, Central Karoo DM, Beaufort West LM	31° 52' 49" 22° 5' 21"	31° 53' 2" 22° 5' 20"	Northern Cape Government: Department of Roads and Public Works; and Western Cape Government: Department of Transport and Public Works	

Watercourse Crossing (No. & road)	Current Situation	Province and Municipality	Coordinates (North)	Coordinates (South)	Road reserve Landowners	Photograph
5. R381	Concrete bridge (dated 1952)	Northern Cape, Pixley ka Seme DM, Ubuntu LM	31° 32 ' 1" 22° 20 ' 27"	31° 32' 23" 22° 20' 19"	Northern Cape Government: Department of Roads and Public Works	 
6. R381	Concrete bridge (undated)	Northern Cape, Pixley Ka Seme DM, Ubuntu LM	31° 33' 17" 22° 21' 2"	31° 33' 33"; 22° 21' 7"	Northern Cape Government: Department of Roads and Public Works	
7. R381	Washed away, with recent repairs flood-damaged again in 2022	Western Cape, Central Karoo DM, Beaufort West LM	31° 38' 28" 22° 21' 10"	31° 38' 35" 22° 21' 10"	Western Cape Government: Department of Transport and Public Works	
8. R381	Concrete bridge with blocked culverts	Western Cape, Central Karoo DM, Beaufort West LM	31° 40' 27" 22° 21' 27"	31° 40' 42" 22° 21' 34"	Western Cape Government: Department of Transport and Public Works	
N1 Bypass	No existing road reserve but gravel tracks present over much of the alignment. Also	Western Cape, Central Karoo DM, Beaufort West LM	32° 19' 56" 22° 35' 7"	32° 21' 41" 22° 32' 45"	Farm 185 & RE Erf 5372: Beaufort West Local Municipality	Previously assessed in Orton (2021b, 2021c, 2021d).

Watercourse Crossing (No. & road)	Current Situation	Province and Municipality	Coordinates (North)	Coordinates (South)	Road reserve Landowners	Photograph
	includes a watercourse crossing upgrade: Low water cement drift with blocked culverts					

4.4. Grid Connection

The remaining electrical infrastructure forms part of the Hoogland Northern Grid Connection application and is subject to a separate environmental authorisation process. This includes switching stations (adjacent to each wind farm substation) and a 132 kV line supported largely by 132 kV monopole pylons that connects to the Nuweveld Collector Substation. This will be transferred to Eskom once operational. The components of the Northern Grid Connection are summarized in Table 4-3below. They include two switching stations on Hoogland 1 Wind Farm and two switching stations on Hoogland 2 Wind Farm. The switching stations are connected by two sections of 132 kV line that combine and travel towards the Nuweveld Collector Substation The Northern Grid Connection is ± 35 km in length, and assuming each pylon is spaced every 260 m and has a footprint of 80 m^2, the respective pylon footprint is 1.08 ha. The four Northern Grid Connection switching stations will collectively have a total footprint of 4.5 ha. For the Northern Grid Connection, it is anticipated that the total area required for the new access tracks is up to 16 ha.

A 5 km wide corridor for this infrastructure was originally assessed during the Pre-application phase and this has been refined and reduced to approximately 2 km wide for this Basic Assessment phase. In addition, within this corridor, a provisional alignment for the 132kV line, that avoids no-go areas, has also been presented on the maps. The ±2 km wide corridor is the subject of the application for environmental authorisation and this assessment. Refer to Figure 4-4 below.

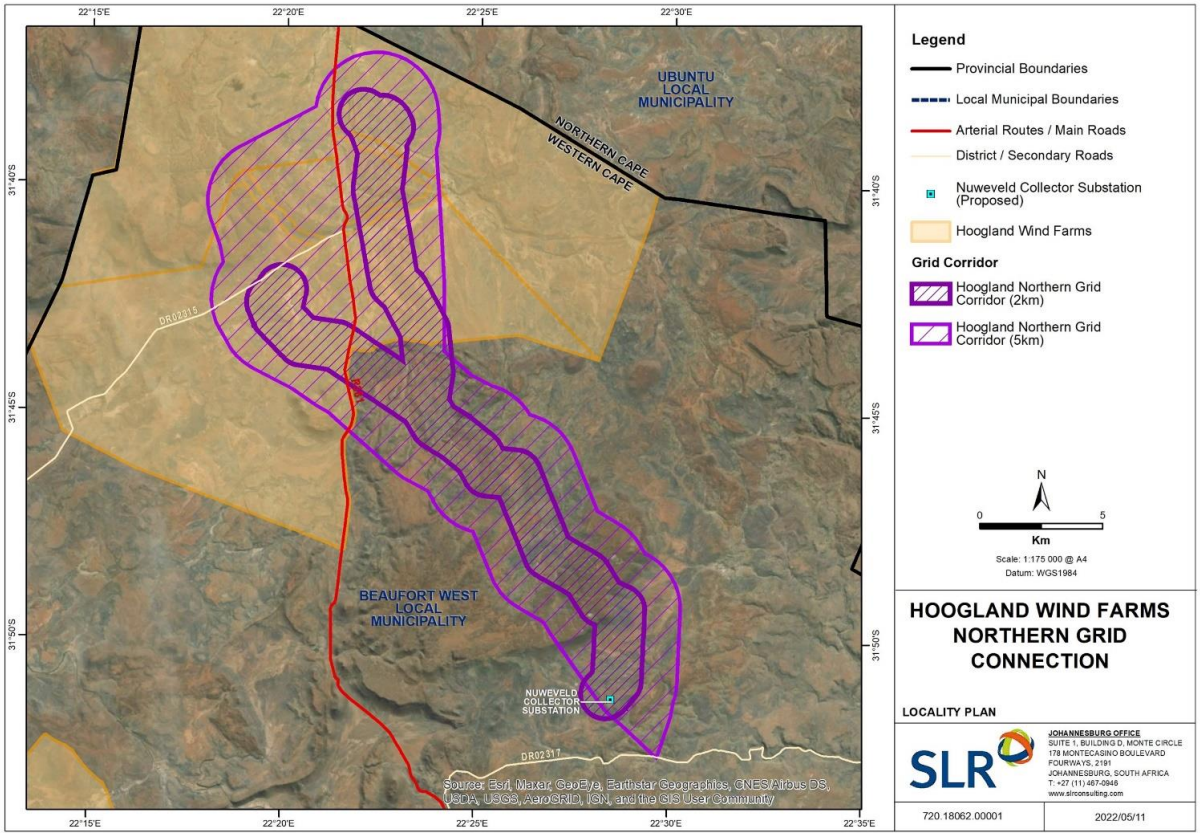

Figure 4-4: Proposed corridor for the Hoogland Northern Grid Connection.

Table 4-3: Summary of the components and approximate areas of impact within the Northern Hoogland Grid Connection Corridor.

Project Components	Description	Hoogland Northern Grid Connection
Locations	Switching station centre point (Hoogland 1A):	31° 38' 34,051" S; 22° 22' 27,326"E
	Switching station centre point (Hoogland 1B):	31° 38' 26,758" S; 22° 21' 56,399" E
	Switching station centre point (Hoogland 2A):	31° 42' 35,857" S 22° 19' 37,022" E
	Switching station centre point (Hoogland 2B):	31° 42' 18,861" S; 22° 19' 55,055" E
Switching stations	There will be two Eskom switching stations on each wind farm with a footprint of approximately 150 x 7 m (11,250 m^2). Each grid connection will therefore have four switching stations in total. The switching station area will include all the standard switching station electrical equipment/components, such as bus bars, metering equipment, switchgear, and will also house control, operational, workshop and storage buildings/areas. Total area for four switching stations:	5 ha (permanent)
Overhead lines and pylons	There will be a 132 kV overhead line supported by mostly monopole pylons approximately 32 m in height. The spans (distance between pylons) on the monopole pylons (without stays) are on average 260 m. Other types of pylons will be used where necessary. The distance of each line, and respective pylon footprint is as follows:	35 km 1.08 ha (permanent)
Access roads and tracks	Existing access roads and tracks (upgraded to ± 2-4 m wide where needed) will be used as far as possible and new access tracks will also be ±2-4 m wide. These are required for all project phases.	16 ha (permanent)
Temporary areas	Temporary laydown areas will be identified along the alignment, with the main equipment and construction yards being located along the alignment or based in one of the surrounding towns or on one of the wind farms. It is anticipated that the total area required for the temporary laydown areas is up to 5 ha.	5 ha (temporary)
Total disturbance footprint:	**Temporary**	**5 ha**
Total disturbance footprint:	**Permanent**	**21.58 ha**

5. BASELINE DESCRIPTION OF THE RECEIVING ENVIRONMENT

5.1. Geological context

The combined project area for the Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection is located in the Upper Karoo region, centered some 20 km south of Loxton and around 75 km north of Beaufort West in the Beaufort West Local Municipality (Central Karoo District) of the Western Cape Province (Figure 1-1) (1: 250 000 topographic sheet 3122 Victoria West). The country here is semi-arid with sparse *bossieveld* vegetation and few trees, except along larger water courses (Figure 5-1 to Figure 5-6). Rugged, rocky upland areas are largely centered on major dolerite intrusions and associated tough-weathering, baked country rocks within their metamorphic aureoles. Examples include the Beesberg – Uilspoort – Kambrokop range (1530-1570 m amsl) that runs west-east across the central sector of the combined project area, the Onrusberg and Die Berg cluster of *koppies* (*c*. 1600-1625 m amsl) in the south, the Rooiplaat region in the northeast and the Blinkpoort se Rante and Bontberg range (*c*. 1600 m amsl) to the southeast. Extensive, low-lying, sandy to gravelly *vlaktes* at around 1435-1470 m with very little bedrock exposure make up most of the remainder of the project area. These areas are drained by a network of shallow, intermittent-flowing water courses that feed into more deeply-incised river systems such as the Slangfontein se Rivier towards the north, the Sakrivier to the south and the Elandsfontein se Rivier to the southwest. Between the two topographic subregions is found distinctive, highly dissected, stepped terrain where exposure of potentially fossiliferous sedimentary bedrocks is above average. Resistant-weathering, yellowish sandstone bodies here build low rocky *kranzes* with aprons of slabby rock rubble, while darker-hued mudrocks are locally well-exposed in river banks, stream gullies, steeper hillslopes and occasional low hills.

Figure 5-1: Typical rocky doleritic terrain in the Beesberg range (Duikerfontein RE/5). Exposure of sedimentary bedrocks in such areas is minimal but thick sandy alluvial deposits here are potentially fossiliferous. The Karoo dolerites themselves are unfossiliferous but may compromise fossil preservation within adjacent country rocks.

Figure 5-2: Low relief terrain mantled by alluvial sands and surface gravels with very limited bedrock exposure occurs in larger portions of the project area, as seen here on Elandsfontein 1/24 looking towards the SE.

Figure 5-3: Pale horizontal bands marking hillslopes on Duikerfontein 2/1 reflect horizons of sedimentary country rocks that have been extensively baked by voluminous dolerite intrusion in the region.

Figure 5-4: Low dolerite hills on the skyline with low-relief terrain in front underlain by baked sedimentary bedrocks and associated tough eluvial gravels of quartzite and hornfels, northern sector of Duikerfontein 2/1.

Figure 5-5: Bedrocks probably straddling the Abrahamskraal Formation – Teekloof Formation boundary on the northern part of Duikerfontein RE/5. The low *kranzes* of yellow-weathering sandstone in the foreground and background are assigned to the Poortjie Member.

Figure 5-6: The dolerite-capped southern escarpment of the Beesberg range on Elandsfontein 1/24 with sandy *vlaktes* in the foreground. The scarp slopes are largely covered by doleritic colluvium with sedimentary bedrock exposure limited to intermittent thin *kranzes* of sandstone on the lower slopes.

The geology of the combined Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection project area is covered by 1: 250 000 geology sheet 3122 Victoria West (Council for Geoscience, Pretoria), with a short sheet explanation by Le Roux & Keyser (1988) (**Figure 5-7**). (*N.B.* The geological context for the central and southern sectors of the Hoogland Northern Grid Connection project area which overlap with the Redcap Nuweveld WEF and grid connection project areas has already been covered by Almond (2020a-c, 2021 and will not be repeated here).

Large portions of the combined project area are underlain by continental (fluvial, lacustrine) sediments of the **Lower Beaufort Group** (**Karoo Supergroup**) of late Middle Permian to early Late Permian age (*c*. 262-257 Ma = million years ago (Johnson *et al.* 2006). Only the uppermost portion of the **Abrahamskraal Formation** is represented within the project area, underlying the northern margins of the Hoogland 1 Wind Farm project area. The correlation of these beds with the Moordenaars Member and / or Karelskraal Member recognized elsewhere in the Main Karoo Basin remains equivocal (*cf* Le Roux & Keyser 1988, p. 6).

The sandstone-rich **Poortjie Member** of the **Teekloof Formation** dominates the rest of Hoogland 1 Wind Farm as well almost all of the Hoogland 2 Wind Farm project areas. The overlying mudrock-dominated **Hoedemaker Member** of the Teekloof Formation only crops out over a small areas along the southern margins of the major Beesberg – Uilspoort dolerite body whose intrusion may have preferentially occurred at this stratigraphic level. A large portion of the Hoedemaker country rocks have therefore been baked and otherwise altered by Karoo-age magmatism. This igneous activity has resulted regionally in an extensive network of dolerite sills and dykes, some of considerable volume, assigned to the **Karoo Dolerite Suite** of Early Jurassic age (*c*. 183 Ma) (McCarthy & Rubidge 2005, Johnson *et al.* 2006, Duncan & Marsh 2006).

Substantial thicknesses of gravelly and sandy to silty **Late Caenozoic alluvium** are associated with major drainage lines within the combined Hoogland Wind Farm project area (pale yellow areas in **Figure 5-7**) and also cover large portions of lower-lying terrain here. Older alluvial deposits, especially in areas overlying dolerite, have often been partially calcretised. In turn, gravelly **colluvial and eluvial deposits** dominated by sandstone, hornfels, quartzite and dolerite rubble mantle plateau areas and most hillslopes. In general, topographic relief is subdued within most of the project area and exposure levels of potentially-fossiliferous Beaufort Group sediments, with few local exceptions, are correspondingly low to very low.

Representative exposures of the main rock units occurring within the combined Hoogland Northern Cluster project area are illustrated in the following section of the report accompanied by short explanation figure legends below:

The main geological units represented on the geological maps include:

- Middle Permian Abrahamskraal Formation (Lower Beaufort Group) – pale blue (Pa).
- Middle to Late Permian Teekloof Formation (Lower Beaufort Group) – green / blue-green. On the Victoria West sheet this formation (Pt) is differentiated into the Ptp = Poortjie Member (Pt, stippled), Hoedmaker Member (Pth) and Oukloof Member (Pto, dark green) (Note the outcrop areas of these members are probably in need of revision). Small black symbols refer to historical fossil sites, very few of which are recorded within the Hoogland project areas.
- Early Jurassic Karoo Dolerite Suite – red (Jd)
- Late Caenozoic alluvium – yellow with “flying bird” symbol

N.B. Most younger superficial deposits (colluvium, eluvial gravels, pedocretes, soils *etc*) are not mapped at 1: 250 000 scale but these obscure the older bedrocks over most of the WEF and grid project area.

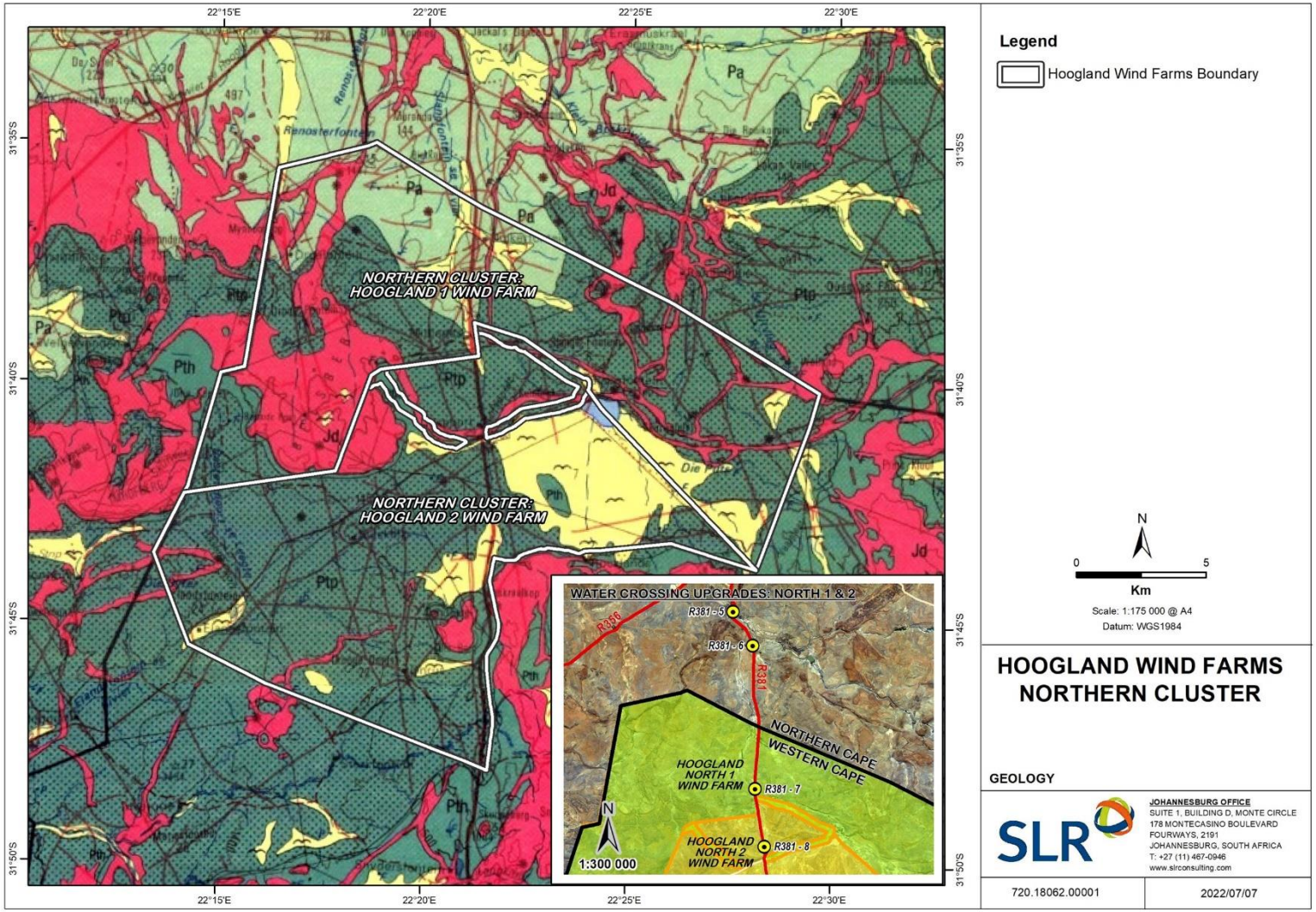

Figure 5-7: Extract from adjoining 1: 250 000 geology sheets 3122 Victoria West (Council for Geoscience, Pretoria) showing the location of the Hoogland 1 and 2 WEF project areas (white polygon). Scale bar = 5 km (Map kindly generated by SLR Consulting).

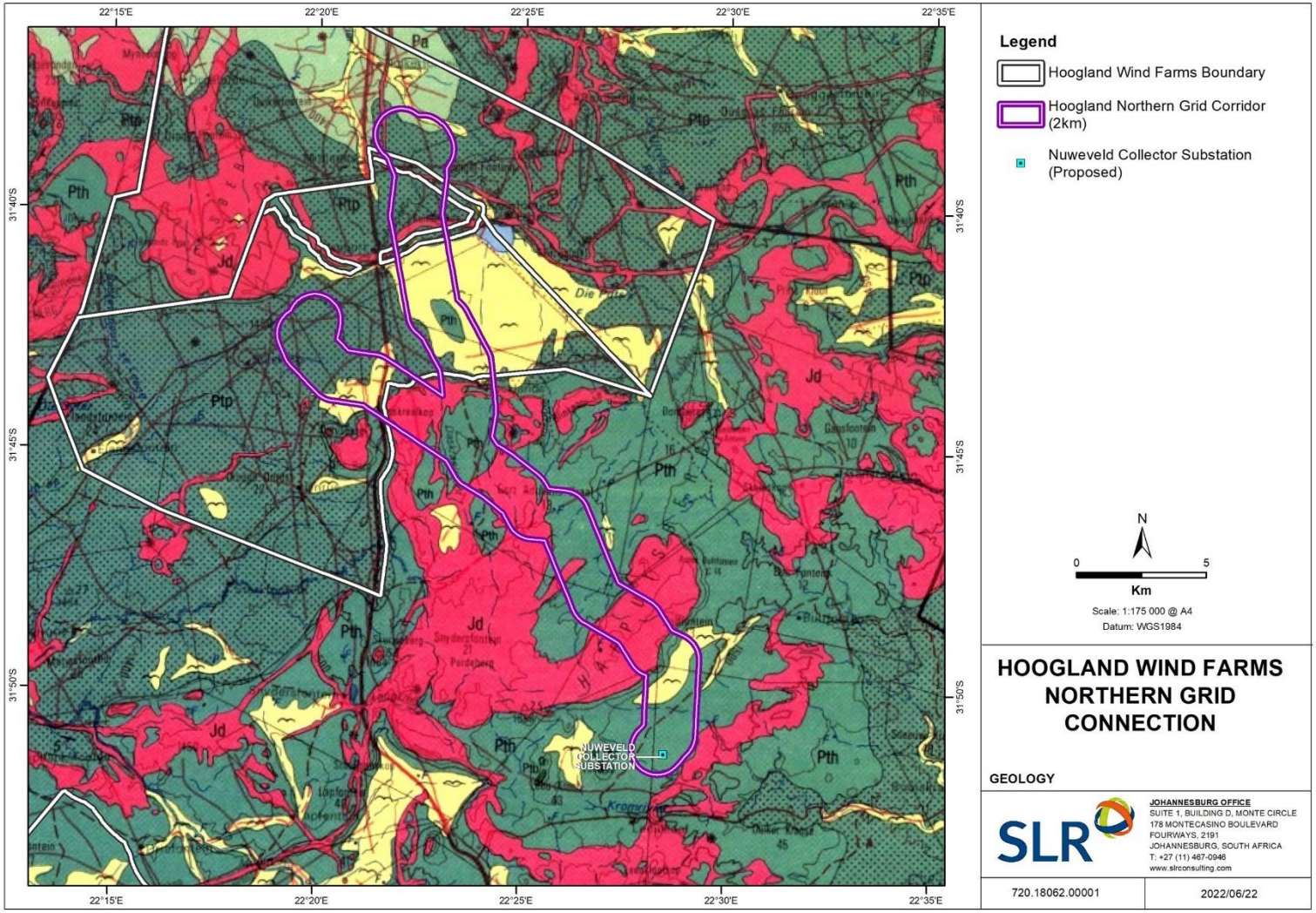

Figure 5-8: Extract from adjoining 1: 250 000 geology sheets 3122 Victoria West (Council for Geoscience, Pretoria) showing the location of the Hoogland north grid corridor (white polygon). Scale bar = 5 km (Map kindly generated by SLR Consulting).

Figure 5-9: Unusually good exposures of tabular-bedded sandstone and mudrock facies of the upper Abrahamskraal Formation along the banks of the Slangfontein se Rivier on Duikerfontein RE/5.

Figure 5-10: Possible upward-coarsening cycles within the uppermost Abrahamskraal Formation along the banks of the Slangfontein se Rivier, Duikerfontein RE/5.

Figure 5-11: Exposure of pale yellowish, well-jointed *tuffite* – bed of mixed volcanic ash and fine-grained terrigenous sediment - within the upper Abrahamskraal Formation on Duikerfontein RE/5. Wave ripples and small invertebrate trace fossils on the upper bedding surface indicate deposition in a shallow lake or pond on the ancient Karoo floodplain. Tuffites can be accurately dated using radiometric methods.

Figure 5-12: Low *kranz* of tabular, pale yellowish-brown channel sandstone capping darker mudrocks that are largely obscured by downwasted sandstone slabs, Duikerfontein RE/5. These beds are mapped within the upper Abrahamkraal Formation but may belong to the lower part of the Poortjie Member (Teekloof Formation).

Figure 5-13: Good exposure of dusky blue-green to purple-brown overbank mudrocks and thin crevasse-splay sandstones of the Poortjie Member, Elandsfontein 1/24.

Figure 5-14: Large scale current cross-bedding within blue-grey and purple-brown siltstone facies of the Poortjie Formation, Droog Fontein 2/1.

Figure 5-15: Good streambank section through purple-brown, thin-bedded mudrocks and overlying channel sandstone of the Poortjie Member, close to the eastern boundary of Slangefontein RE/6 (tributary of Ultvlug se Rivier). This section contains numerous skeletal remains as well as several helical burrows of small-bodied dicynodonts (See Figure 5-40 to Figure 5-46).

Figure 5-16: Thin-bedded to laminated, dark grey mudrocks of possible lacustrine facies on Duikerfontein 1/5 (Hammer = 30 cm). These beds are associated with mudcrack infills, load casts, sandy casts of reedy plant stems and dispersed tetrapod bones, suggesting a pond or lake margin setting.

Figure 5-17: Low hills with gullied exposures of weathered Poortjie Member bedrocks surrounded by low-relief alluvial *vlaktes* on Slangefontein RE/7.

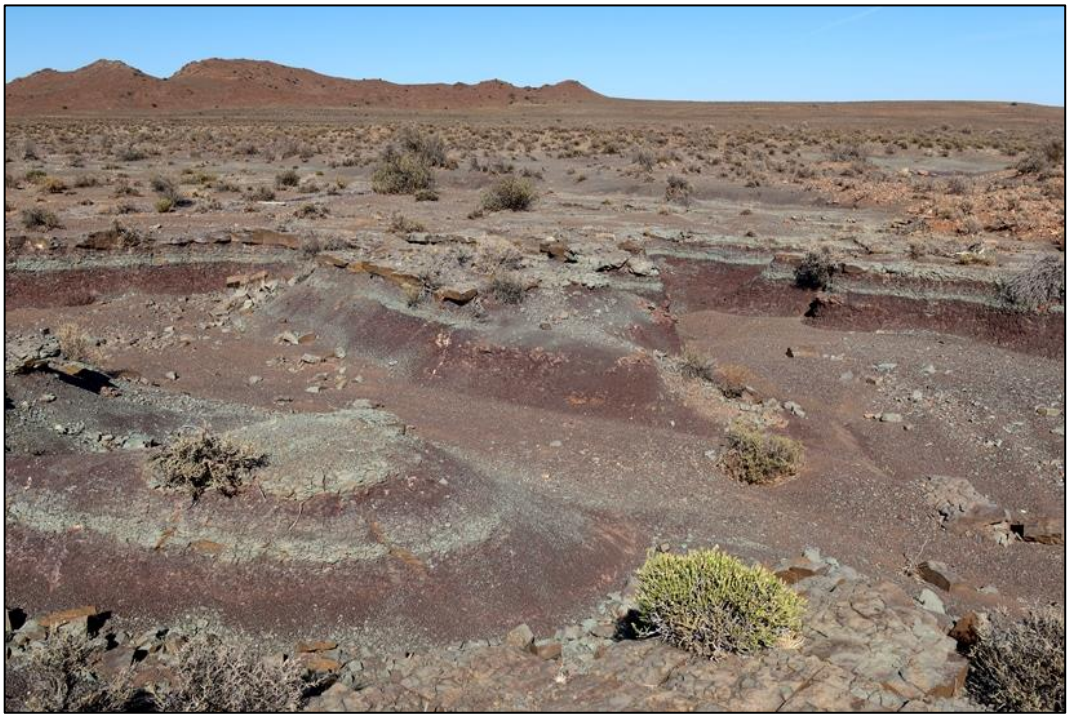

Figure 5-18: Highly-gullied sector of the alluvial *vlaktes* on Slangefontein RE/6 with good exposure of dusky purple-brown and grey-green Poortjie Member mudrocks – ideal for fossil recording.

Figure 5-19: Good hillslope exposures of Poortjie Member mudrocks on the low ridge of Skurwepunt, Slangefontein RE/6. Numerous fragmentary fossil skeletal remains are recorded here (*cf* Figs. Figure 5-36 to Figure 5-38).

Figure 5-20: Unusually thick lenses of calcrete nodule-dominated basal channel breccio-conglomerates within the Poortjie Member exposed on Snydersfontein 1/21. The apparent absence of reworked fossil bones and teeth within these coarse sediments, generate during episodes of intense floodplain degradation, suggest a low abundance of vertebrate life on the ancient Karoo floodplain.

Figure 5-21: Abundant pedocrete (ancient soil) concretions of ferruginous carbonate weathering out from purple-brown overbank mudrocks on Elandsfontein 1/24. Such ancient soil horizons are a primary target for fossil recording in the Lower Beaufort Group.

Figure 5-22: A major inclined dolerite intrusion extending eastwards from the Beesberg sill, seen here at Uilspoort, Slangefontein 1/6. The voluminous rubbly colluvial debris typically shed by dolerite bodies usually obscures adjacent sedimentary country rocks.

Figure 5-23: View along a WSW-ENE trending dolerite dyke on Elandsfontein 1/24 showing the prominent-weathering, pale baked quartzites within its metamorphic aureole.

Figure 5-24: Riverine cliff section through tabular-bedded quartzites and hornfels of the Poortjie Member on Duikerfontein RE/5. This exposure demonstrates the thickness of the metamorphic aureole associated with large dolerite intrusions.

Figure 5-25: Shallow stream bed exposure of pale, baked Poortjie Member quartzites on Duikerfontein RE/5. Note the abundant quartzitic and hornfels gravels in the stream bank here.

Figure 5-26: Dark grey, well-jointed hornfels (baked mudrock) of the Poortjie of Hoedemaker Member exposed in a stream bed, Slangefontein 1/6. The bedrocks in this region are generally mantled by sandy alluvial to aeolian soils. See Figure 5-47 for a baked therapsid skull recorded from this site.

Figure 5-27: Thick development of Late Caenozoic (possibly Pleistocene) calcrete overlying weathered dolerite exposed in erosion gullies on Slangefontein RE/6.

Figure 5-28: A thick carpet of locally gullied, sandy to fine gravelly alluvial sediments covers the bedrocks in low lying areas such as this on Drooge Onrust 1/22.

Figure 5-29: Deeply incised drainage line on Slangefontein RE/6 revealing the considerable thickness of semi-consolidated to unconsolidated Late Caenozoic sandy alluvial sediments covering the Beaufort Group bedrocks in some areas.

Figure 5-30: Featureless sandy *vlaktes* along the Basterspoort se Leegte among dolerite *koppies* on Bastards Poort 2.

Figure 5-31: Stream gulley section through thick, semi-consolidated sandy alluvium and soils in a doleritic landscape on Duikerfontein RE/5. The older, orange-hued older alluvial deposits are partially calcretised, with cracks, burrow-infills and rhizoliths (root casts) picked out by weathering. See also Figure 5-58.

Figure 5-32: Partially consolidated, poorly-sorted, rubbly infill of an ancient alluvial / colluvial channel ("High Level Gravels") now suspended about a meter above present stream bed level (Hammer = 30 cm), Duikerfontein RE/5.

5.2. Palaeontological heritage context

The Lower Beaufort Group of the Main Karoo Basin of South Africa is internationally famous for its remarkably rich fossil record of continental biotas (vertebrates, vascular plants, microfossils) of Middle Permian to Early Triassic age (*e.g.* Smith *et al.* 2012, 2020). These rocks and fossils span two critical mass extinction events in the history of life on Earth: the end Middle Permian Mass Extinction of *c*. 260 Ma and the Permo-Triassic Mass Extinction at *c*. 252 Ma (*cf* Rubidge 1995, 2002, McCarthy & Rubidge 2005, Day *et al.* 2015b, Day & Rubidge 2021). In general, the palaeosensitivity of the Lower Beaufort Group is accordingly rated as High to Very High (*e.g.* SAHRIS website), as also seen in the site sensitivity maps in screening reports for the Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection based on the DFFE Screening Tool (See Appendix 3).

Based largely on tetrapod (4-legged vertebrate) fossils and the lithostratigraphy, the fossil assemblages within the Abrahamskraal and Teekloof Formations cropping out in Hoogland 1 & 2 Wind Farm and Grid Connection project areas are assigned to the ***Tapinocephalus* Assemblage Zone** (AZ) of late Middle Permian (Capitanian) age and the lower part of the succeeding ***Endothiodon* AZ** which is mostly of Late Permian (late Capitanian to Wuchiapingian) age (Smith *et al.* 2020, Day & Rubidge 2020, Day & Smith 2020) (The latter AZ largely replaces the previously-defined *Pristerognathus* and *Tropidostoma* Assemblage Zones of Rubidge 1995) (See biostratigraphic chart Figure 5-33 as well as Figure 5-35).

Because of the regional paucity of good sedimentary bedrock exposures (especially of mudrock facies), most of the combined Hoogland Wind Farm project area has remained palaeontologically unexplored until recently, with comparatively few fossil sites from the Beaufort Group marked on published geological and fossil database maps (Figure 5-7 and Figure 5-34). However, the Hoedemaker Member in the region south of Loxton has yielded several remarkable concentrations of therapsid ("mammal-like reptile") fossils of the *Endothiodon* Assemblage Zone (previously *Tropidostoma* AZ) in the neighbouring Nuweveld WEF project area (*cf* Smith 1993b, Almond 2020a-c, 2021) as well as the Hoogland 3 Wind Farm project area (Almond, 2022). These palaeontological "hotspots" might reflect persistent sites of high-water tables and ponds on the ancient Karoo floodplain. Due to extensive baking of Hoedemaker Member sediments in the present northern Hoogland Wind Farm project area, as well as very low exposure levels of this stratigraphic interval attributable to extensive cover by doleritic, quartzitic and hornfels surface gravels of colluvial / eluvial origin, comparable concentrations of well-preserved therapsid fossils are not expected in the Hoogland Northern Cluster project area.

New fossil records from the combined Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection project areas are tabulated in Appendix 2 with GPS locality data, a brief description, proposed field rating and any relevant mitigation measures. Selected examples of new fossil finds are illustrated below in Figure 5-36 to Figure 5-59. Please note that the fossils recorded can only represent a small fraction of all fossil sites present at surface, let alone in the subsurface, here. The absence of recorded fossils in a given area does not mean they are not present. The fossil assemblages recorded within each major sedimentary rock unit are briefly summarized below.

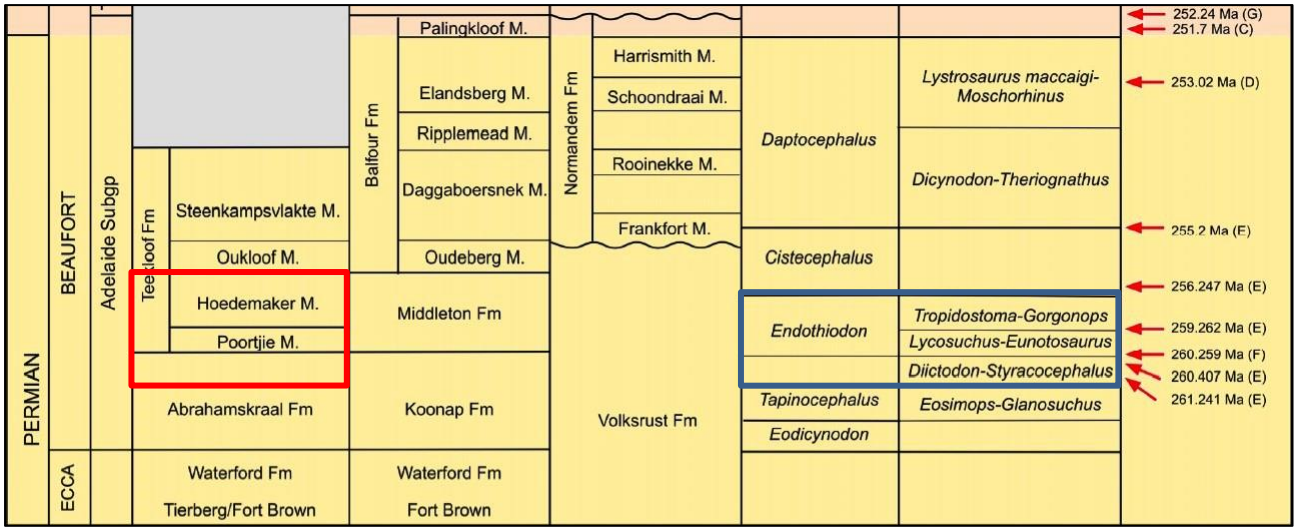

Figure 5-33: Chart showing the latest, newly revised fossil biozonation of the Lower Beaufort Group of the Main Karoo Basin (abstracted from Smith *et al.* 2020). Rock units and fossil assemblage zones mapped within the combined Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection project areas are outlined in red and blue respectively.

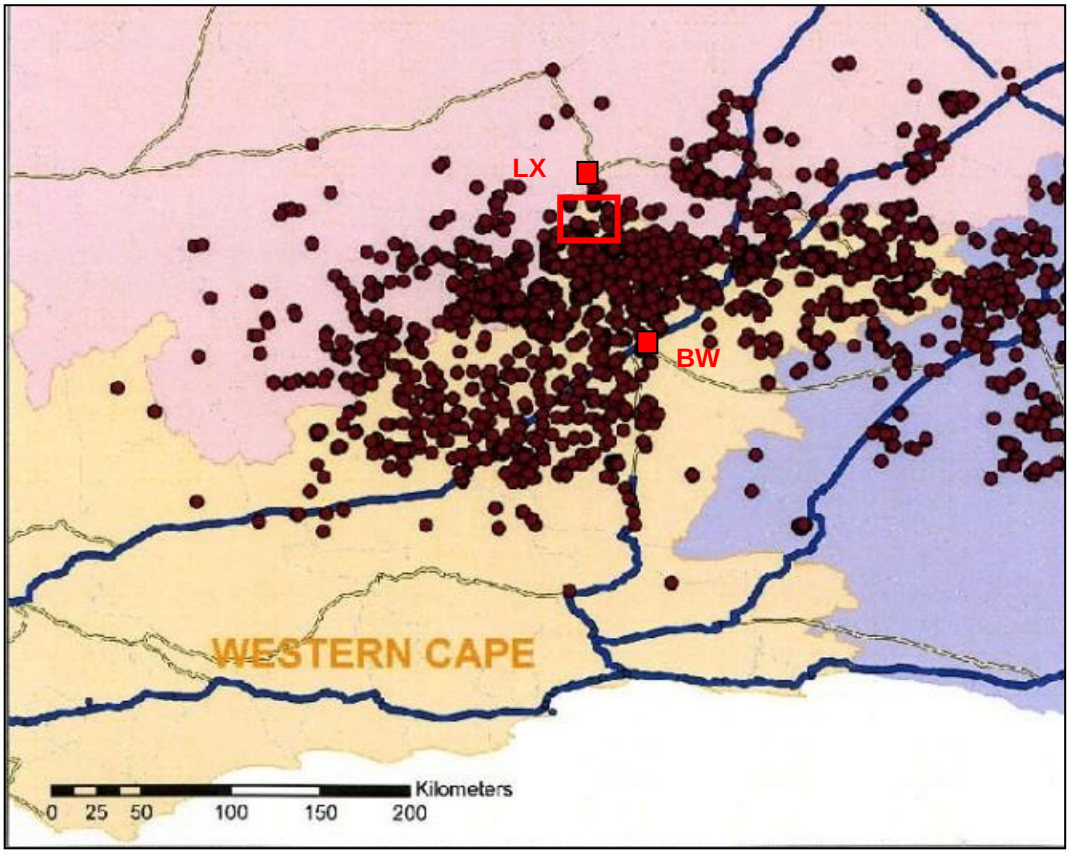

Figure 5-34: Distribution of recorded vertebrate fossil sites within the southern portion of the Main Karoo Basin (modified from Nicolas 2007). The *approximate* location of the combined Hoogland 1, Hoogland 2 and Hoogland Northern Grid Connection project area between Beaufort West (BW) and Loxton (LX) is indicated by the small red rectangle. The low density of previously recorded fossil sites within the northern portion of the combined WEF project area compared to areas of higher relief and bedrock exposure situated closer towards the Great Escarpment to the south is seen here. The lack of unmetamorphosed Hoedemaker Member bedrocks in the northern project area is probably also a factor.

Abrahamskraal Formation

Given current uncertainty concerning the stratigraphy of the Abrahamskraal Formation / Teekloof Formation boundary in the region south of Loxton (*cf* Le Roux & Keyser 1988, p. 6), the stratigraphic provenance of several of the recent fossil finds on the northern margins of the project area is ambiguous. The currently published geological map (Figure 5-7) is provisionally followed here.

No vertebrate skeletal remains were recorded from the Abrahamskraal beds during the recent palaeontological survey, despite occasional good exposure of both mudrock and sandstone facies, including well-developed palaeosol horizons. The presence of burrowing tetrapods – probably small dicynodonts for the most part – is indicated by characteristic large-scale, comb-like scratches on the sole surfaces of channel sandstone beds (*cf Cruziana*) (Figure 5-58) as well as several equivocal tetrapod burrow casts. Smaller, mud-lined horizontal burrows around 4 cm wide might be of invertebrate origin (Figure 5-59). Rippled sandstone surfaces textured by pustulose microbial mats show well-preserved, small-scale invertebrate burrows of the *Scoyenia* Ichnofacies that is associated with damp substrates such as pond and lake margins (Figure 5-63 to Figure 5-65). Some of the narrower burrows may be attributable to undermat miners such as insects. Plant fossils recorded here from the Abrahamskraal beds include fragmentary transported stems (Figure 5-66) as well as possible (but equivocal) moulds of woody axes within channel sandstones *plus* locally abundant casts of reedy plant stems (probably equisetalean ferns or horsetails) found along the rippled and mud-cracked margins of palaeolakes and ponds.

Poortjie Member

Most of the known body fossil and trace fossil sites within the project area have been recorded from sandstone and mudrock facies within the Poortjie Member, the lowermost subunit of the Teekloof Formation. Even where levels of bedrock exposure are locally very good, fossils are generally rare within these beds, probably as a consequence of the end Middle Permian environmental crisis and associated global mass extinction event (Day & Rubidge 2021). Only two concentrations of vertebrate skeletal material have been recorded within these beds so far. Locally abundant skulls and postcrania of small dicynodonts (probably *Diictodon*) occur within heterolithic, channel bank facies of the Poortjie Member on the eastern margins of Slangefontein RE/6. While some of the fossils are enclosed within pedogenic calcrete concretions, others represent animals that were entombed within their sand-infilled burrows (Figure 5-40 to Figure 5-46). Several distinctive casts of helical burrows resembling giant snail shells occur within these beds, some of which are partially calcretised (*cf* Smith 1987) (Figure 5-45 to Figure 5-46). Elsewhere on Slangefontein RE/6 fragmentary postcranial remains of one or more medium-sized therapsids - probably a therocephalian like *Pristerognathus* - are recorded within channel sandstone and pedogenic calcrete facies, as well as eroded-out among surface float (Figure 5-36 to Figure 5-38). Highly-weathered fragments of sizeable bones which have probably eroded out of a channel breccia on Farm Duikerfontein 1/5 are unfortunately unidentifiable but might be attributable to relict dinocephalians, pareiasaurs or perhaps large-bodied dicynodonts such as *Endothiodon* (Figure 5-48).

One of the most interesting palaeontological features of the Poortjie Member within the present study area is the occurrence of a laterally-persistent, densely-burrowed zone of massive, mottled reddish-brown

siltstone or medium-bedded silty sandstone (*cf* fine-grained loess in areas without vegetation). The zone is often marked today by a dearth of *bossieveld* vegetation, perhaps as a result of its peculiar composition and / or geohydrological properties. Good examples of this facies are seen on gentle to dissected hillslopes on farms Elandsfontein 1/24 and Drooge Onrust 1/22, but it also extends onto other land portions (Figure 5-49, Figure 5-50 and Figure 6-2). The zone is characterized by dispersed ferruginous carbonate concretions (*i.e.* not arranged into discrete pedocrete horizons) as well as locally abundant tetrapod burrow casts (Figure 5-51 to Figure 5-56) but so far no vertebrate skeletal remains have been found here. Since the matrix as well as the infill of the burrow casts are of very similar grain-size, the burrows are often rather cryptic but are they are often picked out by weathering. The burrows range in width from roughly 15 to 25 cm, are subhorizontal to inclined, straight to gently curved, elliptical in cross-section, and sometime end in a broader, rounded terminal chamber. Interesting features seen in these burrow assemblages include (1) well-developed chevron-shaped sets of scratch marks across the entire *upper* surface, (2) several superimposed phases of burrow infill and / or construction, generating a *Teichichnus*-like geometry, (3) distinctive smoothed, flat to gently concave, repeated burrow floors at various levels, and (3) intense bioturbation of the burrow floors by small-scale invertebrate burrows – perhaps generated by insects or other animals feasting on damp, organic-rich detritus that accumulated here when the burrow was occupied.

Sandstone palaeosurfaces developed on the top of thin, crevasse-splay sandstones are related to shallow ponds and lakes on the ancient Karoo floodplain. Horizons of load casts, dark laminated mudrocks, locally abundant gypsum pseudomorphs as well as upward-fining sediment packages may also be attributable to lacustrine settings. The palaeosurfaces often display various types of small-scale wave ripples (double-crested, ladderback *etc*), pustulose microbial mat textures, polygonal desiccation crack infills as well as a range of trace fossils. These last include cylindrical casts of reedy plant stems (probably sphenophyte ferns), small arthropod trackways (perhaps insectan) and *Scoyenia* Ichnofacies burrows, as well as large, ill-defined depressions which *might* be undertracks of a tetrapod walking along a pond margin (Figure 5-60 to Figure 5-62).

Hoedemaker Member

Given the small outcrop area of the Hoedemaker Member within the project area as well as the fact that the majority of this mudrock-dominated succession has been baked by dolerite intrusion here, comparatively few fossils are recorded from this stratigraphic unit (in contrast to the local high concentrations of therapsid fossils recorded from these beds in the Hoogland 3 and Nuweveld Wind Farm project areas). A population of tetrapod and possible smaller invertebrate burrows from fine-grained mudrocks and wackes is exposed in a dam overflow on Slangefontein RE/6; these have already been recorded by Almond (2020a-c, 2021) (Figure 5-57). An isolated skull of a small, toothy tetrapod – probably a carnivorous therocephalian – within a stream exposure of black hornfels on Slange Fontein 1/6 shows clear evidence of secondary alteration by heat and circulating mineral-rich fluids during dolerite intrusion (Figure 5-47); as a consequence, such material is usually of limited scientific or conservation value.

Late Caenozoic superficial deposits

These younger deposits blanketing the Lower Beaufort Group bedrocks are largely unconsolidated and unfossiliferous. The only fossils recorded within them are local concentrations of ill-defined, calcretised rhizoliths (plant root casts) and / or invertebrate burrows (*e.g.* of termites) within older, semi-consolidated alluvial deposits (Figure 5-68 to Figure 5-69). They occur both in orange-hued sandy alluvium found in many doleritic areas as well as thicker, gravelly to sandy alluvium encountered along major drainage lines such as the Slangfontein se Rivier.

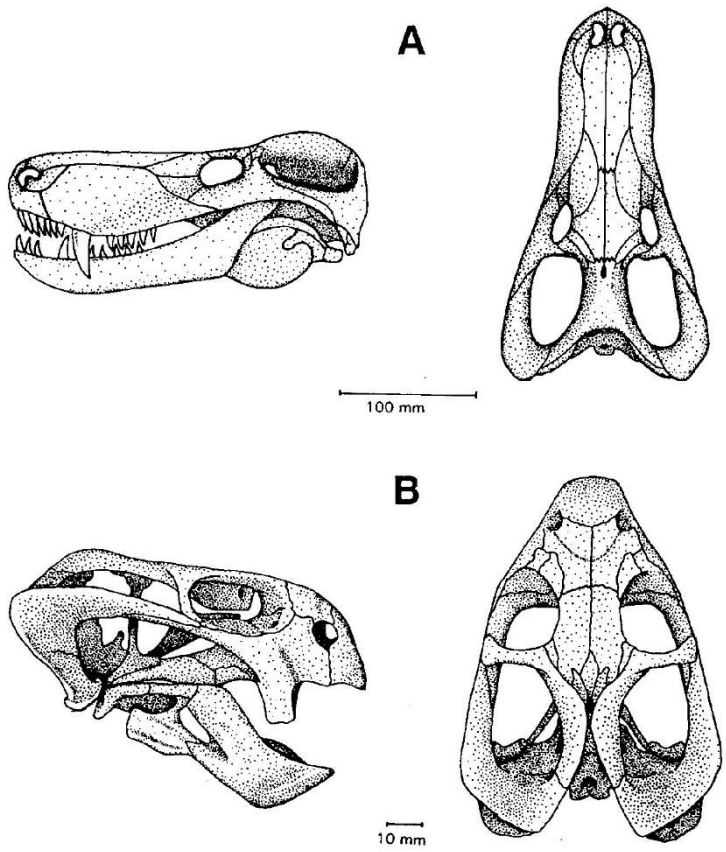

Figure 5-35: Common therapsids from the Poortjie Member of the Teekloof Formation: (A) the medium-sized therocephalian carnivore *Pristerognathus*, and (B) the small-bodied dicynodont *Diictodon* (From Smith & Keyser 1995a). Within the present project area, most of the fossil skeletal material is likely to be *Diictodon*, which is probably also responsible for many of the tetrapod burrows found here. Much rarer carnivore remains represent small to medium-sized therocephalians like *Pristerognathus*. These tetrapod fossil assemblages were previously included within the *Pristerognathus* Assemblage Zone but have recently been transferred to the new *Endothiodon* Assemblage Zone.

Figure 5-36: Fragmentary post-cranial bones of medium-sized tetrapod (possibly a therocephalian), Poortjie Member, Slangefontein RE/6 (Loc. 092) (scale in cm and mm).

Figure 5-37: Disarticulated post-crania (*c*. 10 cm across as seen here) of a medium-sized tetrapod within a channel sandstone of the Poortjie Member, Slangefontein RE/6 (Loc. 094).

Figure 5-38: Greyish pedogenic palaeocalcrete concretion containing postcranial bone of medium-sized tetrapod, Poortjie Member, Slangefontein RE/6 (Loc. 093) (scale in cm).

Figure 5-39: Small (*c.* 10 cm long) dicynodont skull with articulated lower jaw within mottled silty mudrocks of the Poortjie Member, Slange Fontein RE/6 (Loc. 052).

Figure 5-40: Articulated skull of small dicynodont with tusks preserved within a pedocrete concretion, Poortjie Member, Slange Fontein RE/6 (Loc. 071). Skull is *c*. 9 cm long.

Figure 5-41: Skull of a small-bodied dicynodont embedded in grey-green siltstone, Poortjie Member, Slange Fontein RE/6 (Loc. 068).

Figure 5-42: Well-preserved, articulated skull (*c*. 11.5 cm long) of small dicynodont within purple-brown mudrock, Poortjie Member, Slange Fontein RE/6 (Loc. 074).

Figure 5-43: Small dicynodont skull (*c*. 5 cm long) showing palate and skull roof, enclosed within a sandstone burrow cast, Poortjie Member, Slange Fontein RE/6 (Loc. 065).

Figure 5-44: Small articulated dicynodont skull and some postcrania embedded within the terminal chamber of a flattened sandstone burrow cast, Poortjie Member, Slange Fontein RE/6 (Loc. 064) (scale in cm).

Figure 5-45: Helical sandstone casts of several small tetrapod burrows (arrowed) within purple-brown mudrocks of the Poortjie Member, Slange Fontein RE/6 (Loc. 072). See Figure 5-46for more detail.

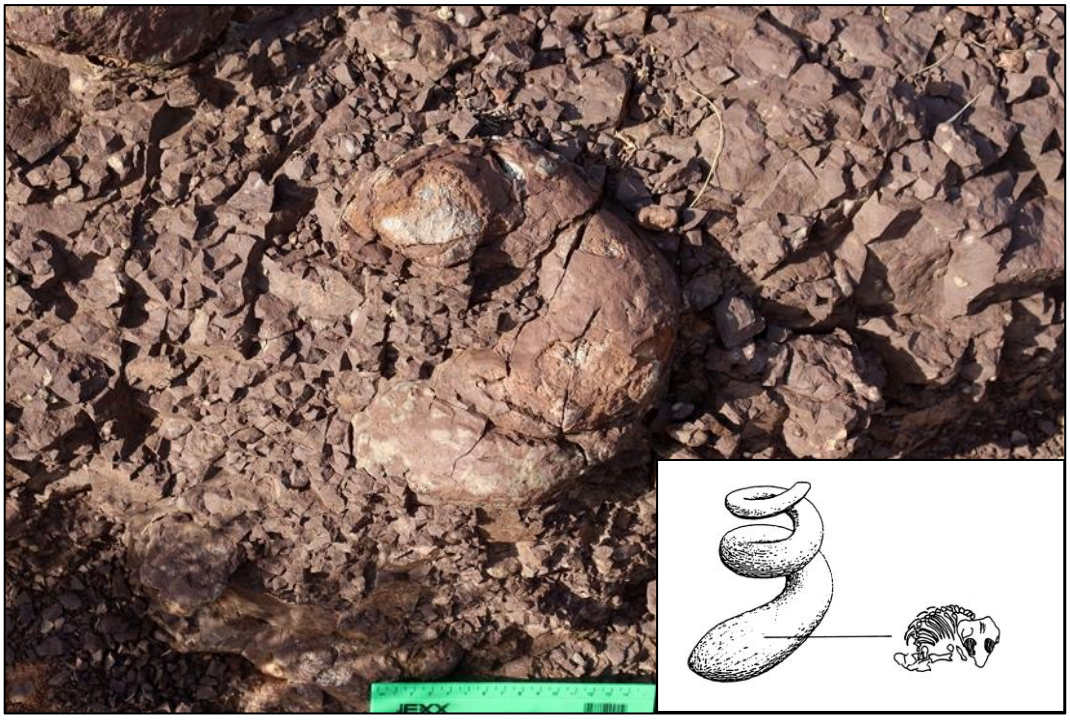

Figure 5-46: Close-up of one of the helical burrow casts shown in the previous figure, Slange Fontein RE/6 (Loc. 072) (scale = 15 cm). The inset from Smith (1987) shows the reconstructed geometry of the burrow.

Figure 5-47: Dark grey hornfels (baked mudrock) containing the skull of a small carnivore (probably therocephalian) which has been altered by thermal metamorphism and mineralisation related to related to dolerite intrusion, Farm Slange Fontein 1/6 (Loc. 100) (See Figure 5-26 for context). The horizon is either the Poortjie or Hoedemaker Member (scale in cm and mm).

Figure 5-48: Float blocks of mudflake breccia from the Poortjie Member with probably associated, weathered piece of robust tetrapod bone (bottom left), Farm Duikerfontein 1/5 (Loc. 445) (scale in cm).

Figure 5-49: Curiously unvegetated zone within the Poortjie Member outcrop area on Farm Elandsfontein 1/24 (Loc. 120). The massive, mottled, purple-brown siltstones here contain numerous cryptic tetrapod burrows and dispersed ferruginous carbonate concretions, but apparently no fossil skeletal material.

Figure 5-50: Close-up of massive, purple-brown bioturbated horizon of the Poortjie Member on Farm Elandsfontein 1/24 (Loc. 117). The prominent-weathering features are mostly tetrapod burrow casts.

Figure 5-51: Weathered-out, subhorizontal to inclined tetrapod burrow cast showing divergent branching (or burrow intersection) and smooth, flat, bioturbated burrow floor, Poortjie Member, Elandsfontein 1/24 (Loc. 116) (scale = 15 cm).

Figure 5-52: Inclined tetrapod burrow cast with elliptical cross section and scratch marks on the upper surface, Drooge Onrust 1/22 (Loc. 185) (scale = 15 cm).

Figure 5-53: Close-up of tetrapod burrow cast (> 12 cm across) showing chevron pattern of scratch marks on the upper surface, Poortjie Member, Drooge Onrust 1/22 (Loc. 183).

Figure 5-54: Comparatively wide (*c*. 25 cm), subhorizontal tetrapod burrow cast with dorsal scratch markings and partially exposed, smooth internal burrow floor, Poortjie Member, Drooge Onrust (Loc. 186) (scale = 15 cm).

Figure 5-55: Partial sandstone cast of a tetrapod burrow showing multi-layered construction and smooth, bioturbated burrow floor on top, Poortjie Member, Elandsfontein 1/24 (Loc. 120) (scale = 15 cm).

Figure 5-56: Close-up of smooth tetrapod burrow floor showing dense bioturbation by invertebrate burrows, possibly exploiting a carpet of damp, organic-rich material here, Poortjie Member, Elandsfontein 1/24 (Loc. 120) (scale = 15 cm).

Figure 5-57: Cross-cutting, smooth-floored, subhorizontal tetrapod burrows in a dam overflow exposure of dark grey siltstones of the Poortjie Member on Slange Fontein RE/6 (Loc. 173) (Scale = 15 cm).

Figure 5-58: Channel sandstone sole surface of the upper Abrahamskraal Formation covered in comb-like sets of scratch marks attributed to tetrapod burrowing or foraging, Duikerfontein RE/5 (Loc. 024) (Hammer = 30 cm).

Figure 5-59: Curved, smooth, pale-grey, mud-lined burrow within fine-grained wackes of the upper Abrahamskraal Formation, Duikerfontein RE/5 (Loc. 023) (scale in cm).

Figure 5-60: Wave-rippled sandstone palaeosurface exposed along stream banks on Slange Fontein 1/6 (Loc. 435). These surfaces display a range of trace fossils associated with shallow lake or pond settings (see following two figures).

Figure 5-61: *Possible* tetrapod undertracks impressed into a wave-rippled palaeosurface, Poortjie Member, Slange Fontein 1/6 (Loc. 435).

Figure 5-62: Walking trail (*c.* 3.5 cm wide) of a small arthropod - possibly insectan - with central longitudinal drag marks preserved on a sandstone palaeosurface, Poortjie Member, Slange Fontein 1/6 (Loc. 433).

Figure 5-63: Sandstone bedding surface of the upper Abrahamskraal Formation showing pustulose microbial mat textures and meniscate-backfilled invertebrate burrows of the *Scoyenia* Ichnofacies, Duikerfontein RE/5 (Loc. 046) (scale in cm and mm).

Figure 5-64: Microbial mat textures on current rippled palaeosurface associated with low-diversity invertebrate trace fossils - positive and negative epichnial burrows and furrows (up to 4 mm wide), possibly attributable to small-bodied undermat miners, upper Abrahamskraal Formation or lower Poortjie Member, Duikerfontein RE/5 (Loc. 021).

Figure 5-65: Sandstone upper bedding plane with sinuous negative epichnial invertebrate burrows, upper Abrahamskraal Formation or lower Poortjie Member, Duikerfontein RE/5 (Loc. 021) (scale = 15 cm).

Figure 5-66: Compression moulds of fragmentary, longitudinally-striated, unsegmented plant stems, upper Abrahamskraal Formation or lower Poortjie Member, Duikerfontein RE/5 (Loc. 020) (scale in cm and mm).

Figure 5-67: Thin-bedded crevasse splay sandstone lower bedding plane with mudcrack infills and dense bedding plane assemblages of round, reedy plant stem casts (*c.* 1 cm wide), and possibly also invertebrate trace fossils, Poortjie Member, Duikerfontein 1/5 (Loc. 443).

Figure 5-68: Thick, orange-brown sandy alluvial deposits indoleritic terrain showing dense assemblages of calcretised rhizoliths (and possibly also invertebrate burrows), Duikerfontein RE/5 (Loc. 166) (hammer – 30 cm).

Figure 5-69: Prominent-weathering, subvertical, subcylindrical trace fossils – probably calcretised rhizoliths and / or invertebrate burrows within thick sandy older alluvial deposits, banks of the Slangfontein se Rivier on Duikerfontein RE/5 (Loc. 172) (hammer = 30 cm).

6. SENSITIVITY MAPPING

Provisional palaeosensitivity mapping of the combined Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection project area based on (1) the SAHRIS palaeosensitivity map as well as (2) the DFFE screening tool suggests that most of the area is of Very High sensitivity, based on the occurrence here of sedimentary bedrocks of the Lower Beaufort Group (See Site Sensitivity Verification Report in Appendix 3). Exceptions recognized include (1) dolerite intrusions (Insensitive) and (2) areas mantled by thick alluvial deposits (Medium Sensitivity). Based on desktop analysis as well as the recent 10-day palaeontological site visit, however, it is concluded that the majority of the project area is, in practice, of Low Palaeosensitivity. This is mainly due to (1) extensive baking of potentially fossiliferous bedrocks by major dolerite intrusions which has compromised fossil preservation; (2) low exposure levels of sedimentary bedrocks due to pervasive cover by low-sensitivity Late Caenozoic superficial sediments (alluvium, colluvium, surface gravels *etc*), (3) the rarity of fossils within the Lower Beaufort Group beds concerned as a consequence of the major global Mass Extinction Event of late Middle Permian age.

The majority of fossil sites recorded within the project area are of low scientific or conservation value and therefore do not warrant mitigation (See data table in Appendix 2). The proposed layouts of the Hoogland 1 Wind Farm and Hoogland 2 Wind Farm do not directly or indirectly threaten any of the know fossil sites which all lie > 20 m outside the project footprints (Appendix 2, Figures. A2-1 to A2-3). Two concentrations of fossil sites were identified within the Hoogland Northern Wind Farm Cluster project area during the Screening Phase[1]:

- The **Hoogland Fossil Site 3** on the eastern margins of Slangefontein RE6 (Hoogland 1 Wind Farm project area) comprises a concentration of fossil skeletons and burrows of small-bodied therapsids. It is associated with stream bank exposures just east of a farm dam and will therefore be protected within the standard riverine ecological buffer zone. It lies > 750 m *outside* the proposed WEF infrastructure footprint and no mitigation of the site is therefore required (Figure 6-1).
- The **Hoogland Fossil Site 4** on Elandsfontein 1/24 (Hoogland 2 Wind Farm project area) encloses several good exposures of intensely-burrowed (but otherwise fossil-poor) mudrocks on gullied hillslopes. Fieldwork suggests that this zone extends onto adjoining land parcels and it does not represent a unique or very limited heritage resource. The known fossil burrow sites here lie 300 m or more *outside* the proposed WEF infrastructure footprint and no mitigation of these sites is therefore required (Figure 6-2). Potential additional sites within the broader burrowed zone can be mitigated, if necessary, through the proposed pre-construction palaeontological walkdown of the final authorized footprint.

Palaeontologically more sensitive areas within the Hoogland Northern Grid Connection project area that overlap with the Nuweveld WEF project area (mapped by Almond 2020a-c, 2021) are largely located along drainage lines where they should be protected within the specialist ascribed aquatic and ecological buffer zones (Figure 6-3). It is noted that the four small Very High Sensitivity palaeontological research areas identified during the Nuweveld WEF project on Leeu Kloof 43 which are to be treated as No-Go areas all lie *outside* the Hoogland Northern Grid Connection project area.

The potential, and largely unpredictable occurrence of further, undocumented palaeontological sites of High to Very High Palaeosensitivity cannot be completely excluded, however. The final authorised Wind Farm

[1] Note that a total of five High Palaeosensitivity fossil sites were found across all of the Hoogland Project sites during Screening, only two of which lie within the Northern Cluster project area.

and Grid Connection layouts should be cross-checked against the fossil database and satellite imagery. Limited pre-construction palaeontological surveys of selected, potentially-sensitive, previously unsurveyed sectors of the authorised Wind Farm and Grid Connection footprint by a professional palaeontologist may be required. In the case of the Hoogland Northern Wind Farms as well as the Grid Connection developments, micro-siting adjustments of infrastructure layout (wind turbines, pylons, access roads *etc*) as a consequence of the palaeontological walk-down are considered to be unlikely due to (1) the paucity of high sensitivity fossil sites in the region and (2) the fact that most fossil sites can be adequately mitigated through professional palaeontological pre-construction recording and sampling / collection.

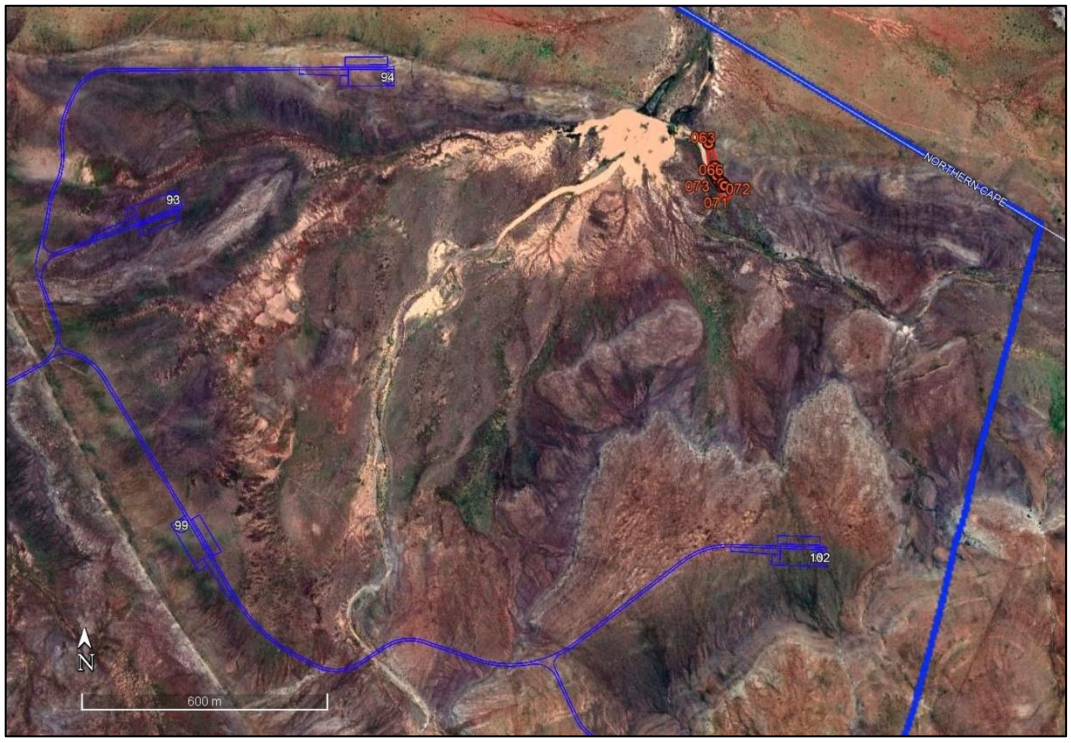

Figure 6-1: Hoogland Fossil Site 3 (red polygon) on the eastern margins of Slangefontein RE6 (Hoogland 1 Wind Farm project area) lies > 750 m *outside* the proposed WEF footprint.

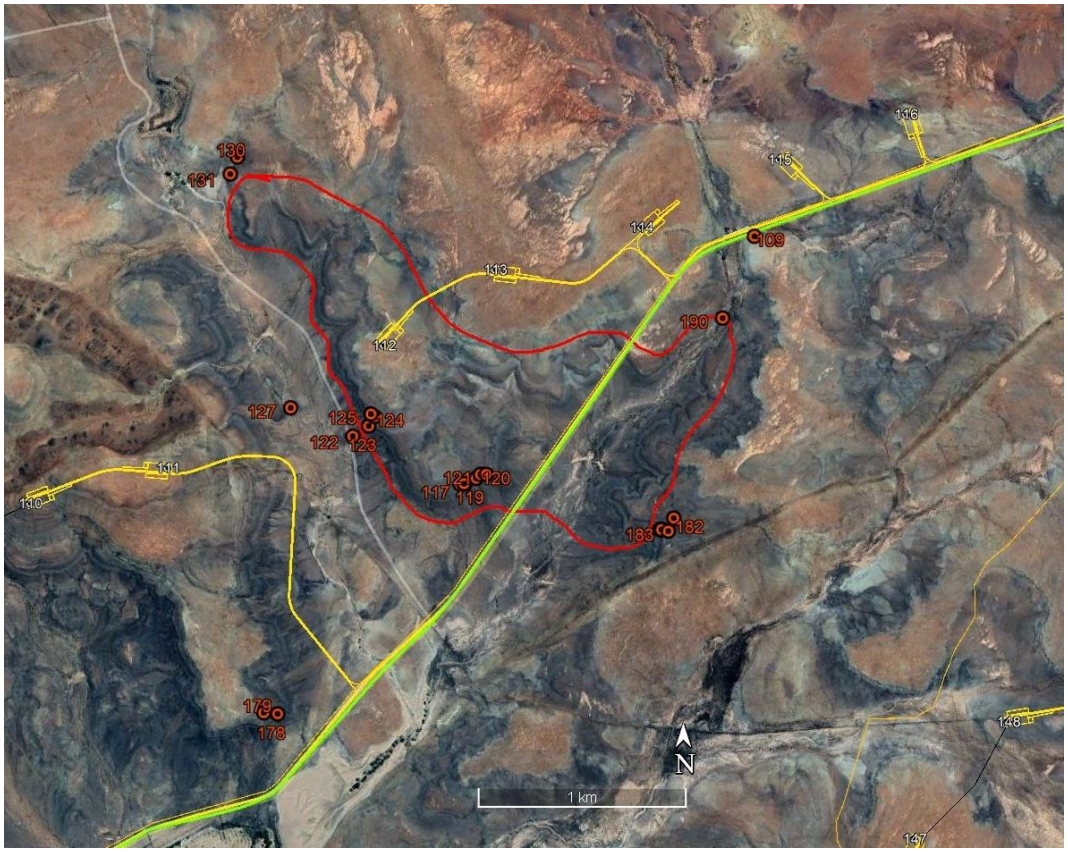

Figure 6-2: Hoogland Fossil Site 4 (red polygon) on Elandsfontein 1/24 (Hoogland 2 Wind Farm project area). Known fossil burrow sites here lie 300 m or more *outside* the proposed WEF footprint and at a lower stratigraphic level.

Figure 6-3: Fossil sites within the sector of the Hoogland Northern Grid Connection project area that overlaps with the Nuweveld WEF project area, as mapped by Almond (2021). Most sensitive fossil sites here are protected within the standard riverine ecological buffer zone.

7. ASSESSMENT OF IMPACTS TO PALAEONTOLOGICAL HERITAGE

Potential impacts on local palaeontological heritage resources due to the Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection are assessed in Table 7-1 and

Table 7-2 below, using the system developed by SLR.

Given the similar geological (and hence palaeontological) setting for all three developments, the results of their separate impact assessments are also very similar. Fossils of some sort occur widely within almost all sedimentary rocks, but most of them are low scientific or conservation value or are very widely distributed (*e.g.* many microfossils, trace fossils). This assessment therefore focuses on fossil heritage that is of potentially high scientific and / or conservation interest and on the construction phase of the developments where impacts are potentially most damaging.

Given (1) the paucity of high sensitivity fossil sites recorded or anticipated within the project area, which is accordingly judged to be of low overall palaeosensitivity, as well as (2) the fact that the known fossil sites all lie well outside the proposed project infrastructure footprints and (3) the potential for effective mitigation of additional chance fossil finds in the pre-construction or construction phase (Section 8 and Appendix 4), the overall palaeontological heritage impact significance of the construction phase of each of the Hoogland 1 Wind Farm / Hoogland 2 Wind Farm / Hoogland Northern Grid Connection is rated as **Low (-ve)** before mitigation and **Very Low (-ve)** after mitigation. Anticipated cumulative impacts of the Hoogland and Nuweveld renewable energy projects (including grid connections) are assessed as **Medium (-ve)** without mitigation, perhaps falling to **Low (-ve)** with full mitigation (Table 7-3). These potential cumulative impacts fall within acceptable limits.

7.1 Impact assessment

Significant impacts on palaeontological heritage are only anticipated for the construction phase of the proposed Hoogland Wind Farms and Grid Connection. These impacts are:

Potential damage, disturbance, destruction or sealing-in of legally-protected and scientifically valuable fossil heritage at or beneath the ground surface within the wind farm / grid connection project area, mainly due to ground clearance and excavations for wind turbine and pylon footings, hard standing areas and access / service roads (the footprints – and hence the impact significance - of the on-site substations, battery storage facilities, O&M buildings, laydown areas and construction areas are small in comparison and are considered collectively with those items mentioned above).

No further significant impacts are expected in the operational and de-commissioning phases of the renewable energy developments.

The palaeontological heritage impact significance of the proposed Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection projects, both before and after mitigation, is assessed in Table 7-1 and

Table 7-2 below. The destruction, damage or disturbance out of context of legally-protected fossils, preserved at the ground surface or below ground, which may occur during *construction phase* of the Wind Farm / Grid Connection entail *direct negative* impacts to palaeontological heritage resources that are confined to the development footprint (*site*). These impacts can often be effectively mitigated but are *permanent* (*v. high duration*) and cannot be fully rectified (*low reversibility*). All of the sedimentary formations represented within the Hoogland Wind Farm and Grid Connection project area contain fossils of some sort (*e.g*. microfossils, trace fossils, vertebrate fossils, *etc.*). Impacts on fossil heritage at *some* level are definite but, given the low palaeontological sensitivity of large portions of the area, they are likely to be, at most, of *low intensity* overall (Local high intensity impacts on highly-significant fossil remains – such as rare vertebrate fossils – cannot be completely excluded, however). *Without mitigation,* impacts on *scientifically important, well-preserved, unique or rare fossil material* that is worthy of special protection / conservation – the real focus of this assessment exercise - are *probable.*

The overall palaeontological heritage impact significance of the construction phase of the Hoogland 1 Wind Farm / Hoogland 2 Wind Farm / Hoogland Northern Grid Connection, adopting a precautionary approach in view of the potentially significant number of unrecorded fossil sites within the project area as a whole, is rated as **Low (-ve)** before mitigation. With full implementation of the palaeontological mitigation measures outlined in Section 8, the impact significance may fall to **Very Low (-ve).** This assessment applies to all the Wind Farm / Grid Connection infrastructure listed in the project description (Section 4).

Although palaeontological field surveying within the extensive Wind Farm and Grid Connection project area is necessarily very incomplete (reconnaissance level) at present, confidence levels for this assessment are rated as *medium*. This is because of the availability of fossil data from the scientific literature and previous PIAs in the region (*viz*. the adjacent Nuweveld Wind Farm and Grid Connection projects) as well as from the recent lengthy, field-based reconnaissance study.

Table 7-1: Assessment of potential palaeontological heritage impacts of each of the proposed Hoogland 1 Wind Farm and Hoogland 2 Wind Farm (Construction Phase)

Issue: Loss or degradation of local palaeontological heritage resources of scientific and / or conservation value		
Description of Impact		
Damage, disturbance, destruction or sealing-in of legally-protected, scientifically valuable fossil heritage at or beneath the ground surface within the wind farm project footprint, mainly due to ground clearance and excavations for wind turbines, hard standing areas, access / service roads, underground cabling and pylon footings.		
Type of Impact	**Direct**	
Nature of Impact	**Negative**	
Phases	**Construction**	
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Very Low
Duration	Permanent	Permanent
Extent	Site	Site
Consequence	Low	Low
Probability	Probable	Possible
Significance	Low -	Very Low -

Degree to which impact can be reversed	Impacts to palaeontological heritage are generally irreversible.
Degree to which impact may cause irreplaceable loss of resources	Low. Most fossils recorded from the project area are of widely occurring forms within the outcrop areas of the formations concerned.
Degree to which impact can be mitigated	Moderate. Most recorded fossil sites can be effectively mitigated by a professional palaeontologist in the pre-construction phase (recording / collection). Newly exposed fossils can be mitigated through a Chance Fossil Finds Procedure. However, residual impacts following mitigation may be locally high, given the unavoidable difficulties of identifying and sampling fossils from on-going construction phase excavations and site clearance.

Table 7-2: Assessment of potential palaeontological heritage impacts of the proposed Hoogland Northern Grid Connection (Construction Phase)

Issue: Loss or degradation of local palaeontological heritage resources of scientific and / or conservation value		
Description of Impact		
Damage, disturbance, destruction or sealing-in of legally-protected, scientifically valuable fossil heritage at or beneath the ground surface within grid connection project footprint, mainly due to ground clearance and excavations for access / service roads and pylon footings.		
Type of Impact	**Direct**	
Nature of Impact	**Negative**	
Phases	**Construction**	
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Very Low
Duration	Permanent	Permanent
Extent	Site	Site
Consequence	Low	Low
Probability	Probable	Possible
Significance	Low -	Very Low -
Degree to which impact can be reversed	Impacts to palaeontological heritage are generally irreversible.	
Degree to which impact may cause irreplaceable loss of resources	Low. Most fossils recorded from the project area are of widely occurring forms within the outcrop areas of the formations concerned.	
Degree to which impact can be mitigated	Moderate. Most recorded fossil sites can be effectively mitigated by a professional palaeontologist in the pre-construction phase (recording / collection). Newly exposed fossils can be mitigated through a Chance Fossil Finds Procedure. However, residual impacts following mitigation may be locally high, given the unavoidable difficulties of identifying and sampling fossils from on-going construction phase excavations and site clearance.	

7.2 Alternatives

Due to the comprehensive iterative design process that has been undertaken to inform the respective Wind Farm layouts and associated infrastructure for the Hoogland Projects, no site or layout alternatives will be assessed.

However, the preferred layouts of the Hoogland Wind Farms, and respective Grid Corridors, will each be assessed against the '**no-go' alternative**. The 'no-go' alternative is the option of not constructing the Project where the status quo of the current farming activities and natural weathering processes on the site would prevail.

The impact significance of the **No-Go Alternative** considers that even without development fossils would still be destroyed by natural weathering and erosion. Other factors such as current farming activities within the project area (*viz.* small stock farming) as well as potential illegal fossil collection are considered to have a negligible effect on local palaeontological resources. In the case of the No-Go Alternative (*i.e.* no Wind Farm / grid development), the likely loss of local heritage resources through construction activities (negative impact) would be avoided while potential improvements in palaeontological understanding through professional mitigation - *i.e.* recording and collection of palaeontological material and data (positive impacts) - would be lost. The slow but relentless destruction of fossils exposed at the surface through natural weathering and erosion would continue, but at the same time new fossils would be revealed and prepared-out for scientific study. On balance, it is concluded that the No-Go alternative would have a *neutral* impact on palaeontological heritage.

7.3 Cumulative Impacts

In relation to an activity, cumulative impact "means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may be significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities" (NEMA EIA Reg GN R982 of 2014).

Other than the proposed Nuweveld Wind Farms, there are currently no approved renewable energy EA applications within a 30km (or even 50km) radius of the project site (Figure 7-1). The nearest operational wind farm from the site is the Noblesfontein Wind Farm located approximately 65km to the northeast. In addition, the South African Renewable Energy EIA Application Database (REEA) ("REEA_OR_2022_Q1") shows several renewable energy projects (solar) have been authorized close to Beaufort West. Further research confirmed that none of these projects are currently going ahead / have a valid EA (It is noted that the Beaufort West – Aberdeen area has recently been gazetted as a Renewable Energy Development Zone (REDZ) and that several new solar and wind farm projects are currently in the process of being assessed). The cumulative impact assessed here will therefore be the collective impact of the four Hoogland Wind Farms and Grid Connection applications with the three Nuweveld Wind Farm and Gridline applications.

The significance of anticipated impacts on palaeontological heritage for each of the three Nuweveld Wind Farms as well as the associated Grid Connection has been assessed as Moderate Negative in each case (Almond 2020a-c, 2021), while all four proposed Hoogland Wind Farms as well as their Grid Connections have been assigned a Medium Negative impact significance regarding palaeontological heritage (Almond 2022.

Anticipated cumulative impacts of the renewable energy projects listed above are assessed as **Medium (-ve)** without mitigation. Overall impact significance may fall to **Low (-ve)** with full mitigation since impacts will then occur at a lower intensity and will be partially offset by valuable new scientific data. The analysis only applies *provided that* all the proposed monitoring and mitigation recommendations made for all these various projects are followed through (*N.B.* This is inherently unpredictable since monitoring of compliance with these recommendations by the regulatory authorities does not generally occur). Unavoidable residual negative impacts may be partially offset by the improved understanding of Karoo palaeontology resulting from appropriate professional mitigation. This is regarded as a *positive* impact for Karoo palaeontological heritage.

It is concluded that the cumulative impacts on local fossil heritage anticipated for the various renewable energy projects in the Upper Karoo region south of Loxton – including the proposed Hoogland and Nuweveld Wind Farms and their associated Grid Connections – fall within acceptable limits, *provided that* all recommended mitigation recommendations for these projects are followed through.

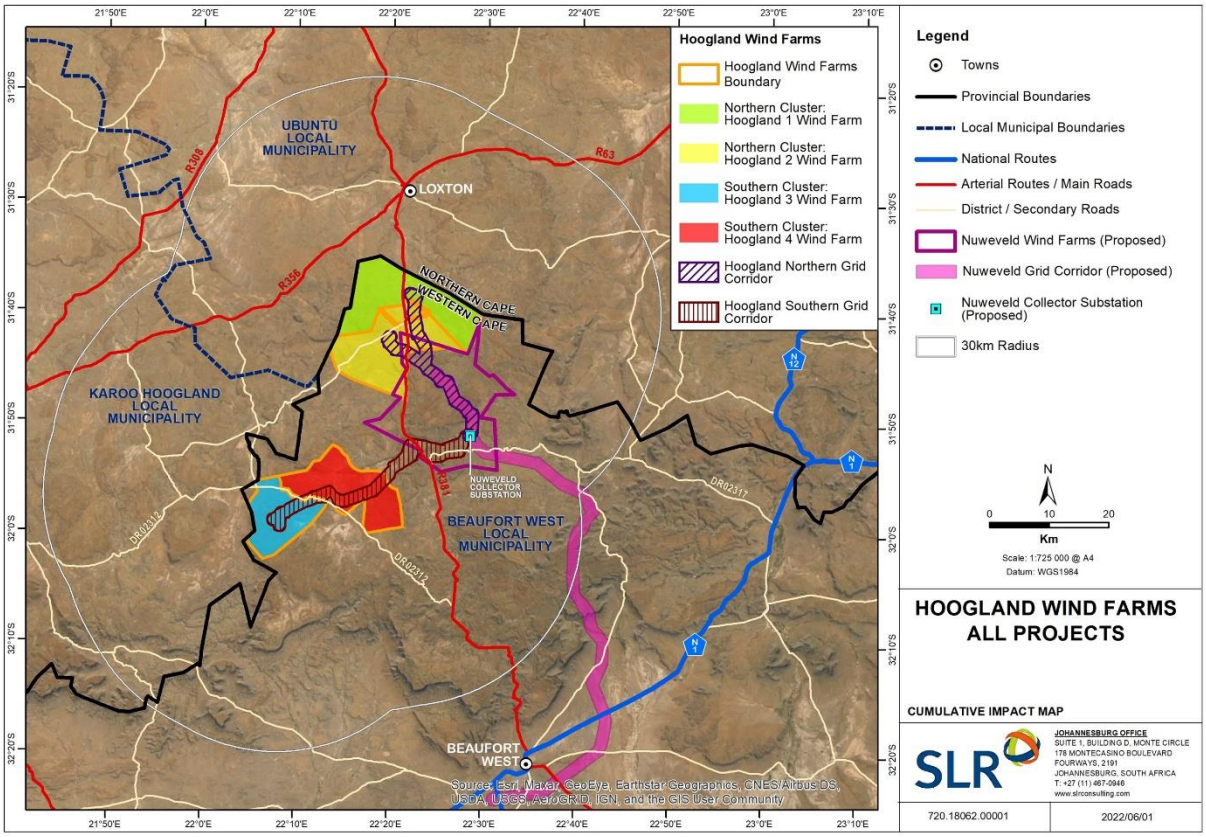

Figure 7-1: Cumulative Map indicating renewable energy facilities within the 30km buffer of the Hoogland Wind Farms and Grid Connection.

Table 7-3: Assessment of potential cumulative palaeontological heritage impacts relating to the proposed Hoogland and Nuweveld Wind Farm and associated grid connection projects.

Issue: Loss or degradation of local palaeontological heritage resources of scientific and / or conservation value
Description of Impact

Damage, disturbance, destruction or sealing-in of legally-protected, scientifically valuable fossil heritage at or beneath the ground surface within wind farm / grid connection project footprint, mainly due to ground clearance and excavations.		
Type of Impact	**Direct**	
Nature of Impact	**Negative**	
Phases	**Construction**	
Nature of cumulative impacts	Potential loss of a significant fraction of scientifically important, rare or unique, fossil heritage within the Palaeozoic bedrocks and Late Caenozoic superficial sediments in the Upper Karoo south of Loxton.	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	Low -

8. MITIGATION AND EMPR REQUIREMENTS

None of the palaeontological sites recorded within the adjoining Hoogland 1 Wind Farm and Hoogland 2 Wind Farm project areas - as tabulated in Appendix 2 - lie within or close to (≤ 20 m) the proposed project footprints (See Figure 6-1 to Figure 6-3 and satellite images A2.1- A2.3 in Appendix 2). No palaeontological mitigation is therefore required with regard to the known fossil sites.

Mitigation measures for the Grid Connection project follow those already outlined by Almond (2021) for the neighbouring Nuweveld Grid Connection project, viz:

1. A pre-construction walkdown of the grid connection alignment and project footprint by a suitably qualified palaeontological specialist, focusing primarily on sectors of inferred high palaeontological sensitivity, with recommendations on micro-siting of the grid connection infrastructure, if required and possible.

2. Avoidance during construction of any very sensitive areas with a high density of *in situ* fossils mapped following the pre-construction walkdown.

3. Professional palaeontological recording and sampling / collection of valuable fossils within the project footprint.

4. If necessary, further pre-construction or construction phase monitoring and mitigation of bedrock excavations by a professional palaeontologist and the ECO, to be specified following the walkdown survey.

5. Application of Chance Fossil Finds Protocol by the ECO and palaeontological specialist during the construction phase (See Appendix 4).

The final, authorised layout of the Hoogland Wind Farm and Grid Connection projects should be cross-checked against the available fossil database and other relevant resources (*e.g.* satellite imagery, geological maps) by the palaeontological specialist who should make recommendations for pre-construction phase mitigation, if any proves necessary. This might entail, for example, focussed palaeontological walk-downs of selected, previously unsurveyed and potentially sensitive sectors of the project footprint with judicious sampling or collection of threatened fossil material of scientific and / or conservation value.

Given the potential for the exposure or recognition of additional, scientifically valuable fossil occurrences within the project footprints, a Chance Fossil Finds Protocol, as outlined below and tabulated in Appendix 4,

must be included within the Environmental Management Programme (EMPr) and fully implemented throughout the construction phase.

The Environmental Control Officer (ECO) / Environmental Site Officer (ESO) responsible for the development should be made aware of the possibility of important fossil remains (vertebrate bones, teeth, burrows, petrified wood, plant-rich horizons *etc.,* such as those illustrated in this report) being found or unearthed during the construction phase of the development. Monitoring for fossil material of all major surface clearance and deeper (>1m) excavations by the ECO/ESO on an on-going basis during the construction phase is therefore recommended. Significant fossil finds should be safeguarded and reported at the earliest opportunity to Heritage Western Cape for recording and sampling by a professional palaeontologist (Contact details: Heritage Western Cape. 3rd Floor Protea Assurance Building, 142 Longmarket Street, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 021 483 5959 Email: ceoheritage@westerncape.gov.za).

An approved Work Plan from Heritage Western Cape will be required by the specialist palaeontologist responsible for mitigation work. Minimum Standards for palaeontological heritage reports and fieldwork have been specified by SAHRA (2013) and Heritage Western Cape (2021).

9. SUMMARY & CONCLUSIONS

9.1 Summary of Findings

The combined Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection project area in the Upper Karoo region near Loxton is underlain by potentially fossiliferous continental (fluvial / lacustrine) sediments of the Lower Beaufort Group (Karoo Supergroup) of Middle to Late Permian age. Few fossil sites have been previously reported from the Abrahamskraal and Teekloof Formations representing the Beaufort Group bedrocks in this area.

During the recent ten-day, reconnaissance-level palaeontological heritage survey of the combined Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and overlapping sectors of the Hoogland Northern Grid Connection project areas by the author and an experienced field assistant a limited number of new fossil sites were recorded (See Appendix 2 for details and satellite mapping). They include several skulls and post-cranial skeletal remains of tetrapods (mainly small-bodied therapsids such as dicynodonts and therocephalians), numerous tetrapod burrow casts, as well as low diversity invertebrate trace fossil assemblages but no unequivocal fossil wood or other well-preserved plant material.

Based on the new field data as well as desktop research it is concluded that:

1. Well-preserved fossils of scientific and conservation interest are remarkably rare within the project area as a whole. This is attributed to (a) poor levels of bedrock exposure associated with generally low relief and pervasive cover by largely unfossiliferous superficial sediments; (b) extensive dolerite intrusion which has “sterilized” large volumes of potentially fossiliferous bedrocks through thermal metamorphism, leaching and secondary mineralisation, while the large dolerite outcrop areas in the uplands are completely fossil-free; (c) highly impoverished fossil biotas within the upper Abrahamskraal – Poortjie Member stratigraphic interval that are associated with the catastrophic end Middle Permian Mass Extinction Event of ~260 Ma.

2. No good fossiliferous exposures of the upper Abrahamskraal Formation (Karelskraal and / or possibly Moordenaars Member) were encountered; away from major drainage lines, this mudrock-dominated unit is largely covered here by superficial deposits. No vertebrate skeletal remains and only a small range of trace fossils were recorded from these older beds.

3. The Poortjie Member is generally very fossil poor, with the exception of a small stream bank exposure featuring several small dicynodont skulls and associated helical burrow casts recorded on Slangefontein RE6 (Hoogland 1 Wind Farm project area). An extensive, laterally-persistent horizon of massive, purple-brown, silty mudrocks cropping out on dissected hillslopes in the Hoogland 2 Wind Farm project area (*e.g.* Elandsfontein 1/24) features numerous, cryptic, small tetrapod burrows but no associated skeletal material. This phenomenon is possibly of scientific interest in shedding light on tetrapod survival of challenging environmental conditions during or shortly after the end Middle Permian Extinction Event through widespread burrowing.

4. The readily-weathering, mudrock-dominated Hoedemaker Member is generally very poorly exposed and extensively intruded or baked and mineralised by major dolerite intrusions within the project area. Dense concentrations of tetrapod skeletal remains and burrows (mainly small, articulated to disarticulated dicynodonts but also rare theriodonts / cynodonts or therocephalians) have been recorded within the Hoedemaker Member in the adjoining Nuweveld North Wind Farm project area (Almond 2020a) as well as the Hoogland 3 Wind Farm project area (Almond 2021, in prep) but only a single, highly altered carnivore skull as well as a dense assemblage of tetrapod burrows were recorded during the present field survey.

5. Fossils within the Late Caenozoic superficial deposits are largely restricted to older, calcretised alluvium (perhaps Pleistocene in age) which contains calcretised rhizoliths (plant root casts) and burrows (*e.g.* termite foraging tunnels and nests) with the potential for rare fossilised mammalian bones of Pleistocene age. With the exception of the fossil mammal material (not yet recorded within the present study area), these fossils are of widespread occurrence within the Karoo region and are not, therefore, of high conservation significance.

6. Extensive areas underlain by Karoo dolerite – where a considerable portion of the Wind Farm and Grid Connection infrastructure will be placed - are almost entirely unfossiliferous. Calcretised plant root casts or invertebrate burrows occur in older sandy alluvial deposits overlying dolerite but such fossils are widely occurring and of low heritage significance.

7. Most of the combined Wind Farm and Grid Connection project area has been provisionally rated as of Very High Palaeosensitivity (SAHRIS website, DFFE Screening Tool) due to the rich Permian fossil assemblages recorded from the Lower Beaufort Group in the Main Karoo Basin. This sensitivity rating is *contested* here. The great majority of the fossil sites recorded within the project area are of limited scientific or conservation value (low Heritage Provisional Field Rating) and in practice the majority of the project area is of Low palaeosensitivity. However, the occurrence of sparse, small, and largely unpredictable fossil sites of High Sensitivity cannot be entirely discounted.

8. None of the known fossil sites within the combined project area lies within or close to (≤ 20m) the proposed project footprints and no palaeontological mitigation is therefore required in their regard. Most additional, unrecorded fossil sites identified during the pre-construction or construction phase can be readily mitigated, if necessary, through a Chance Fossil Finds Protocol, as outlined in Appendix 4.

9. The final, authorised layout of the Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection projects submitted for Environmental Authorisation should be cross-checked

against the available fossil database and other relevant resources (*e.g.* satellite imagery, geological maps) by the palaeontological specialist who should make recommendations for pre-construction phase mitigation, if any proves necessary. This might entail, for example, focussed palaeontological walk-downs of selected, previously unsurveyed and potentially sensitive sectors of the project footprint with judicious sampling or collection of threatened fossil material of scientific and / or conservation value. An approved Work Plan from Heritage Western Cape will be required by the specialist palaeontologist responsible for mitigation work.

10. In terms of palaeontological heritage the Construction Phase impact significance of each of the proposed Hoogland Wind Farm and Grid Connection projects, including all the component infrastructure listed in the project descriptions, is assessed as **Low (-ve)** without mitigation and **Very Low (-ve)** following mitigation. No significant further impacts are anticipated in the Operational and Decommissioning Phases. The impact significance of the No-Go Alternative would most likely have a *neutral* impact on palaeontological heritage. Anticipated cumulative impacts of the closely spaced Hoogland and Nuweveld renewable energy projects in the Upper Karoo region to the south of Loxton are assessed as **Medium (-ve)** without mitigation, falling to **Low (-ve)** with full mitigation of all projects concerned. These levels of cumulative impact fall within acceptable limits.

11. In terms of palaeontological heritage there are no fatal flaws in the proposed Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection renewable energy projects respectively and there are no objections to their authorisation.

12. The palaeontological mitigation measures outlined here in points 8 and 9 above as well as in Appendix 4 should be incorporated into the EMPr for each of the Hoogland renewable energy projects.

9.2 Conclusions and Impact Statement

Despite the Very High provisional palaeosensitivity assigned to large parts of the combined project area for the proposed Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and associated Hoogland Northern Grid Connection developments, desktop and field data suggest that, in practice, the area is of low palaeosensitivity overall, with only a sparse, and largely unpredictable, scatter of fossil sites of scientific and / or conservation value.

In terms of palaeontological heritage resources, the proposed Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and associated Hoogland Northern Grid Connection developments are assigned a similar overall impact significance rating (Construction Phase) of Low (-ve) without mitigation and Very Low (-ve) following mitigation. No significant further impacts on fossil heritage resources are anticipated in the planning, operational and decommissioning phases. The No-Go Option will probably have a neutral impact. Anticipated cumulative impacts in the context of several other renewable energy projects in the Upper Karoo region south of Loxton (*viz*: Hoogland 3 and Hoogland 4 Wind Farms, Nuweveld Wind Farms and their associated grid connections) are assessed as Medium (-ve) significance without mitigation and Low (-ve) significance after mitigation.

The proposed Hoogland Wind Farm and Grid Connection developments are not fatally flawed. On condition that the recommended mitigation measures (including Chance Fossil Finds Protocol) are included within the EMPr and implemented in full during the construction phase, there are no objections on palaeontological heritage grounds to their authorisation.

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APPENDIX 1: JOHN ALMOND SHORT CV

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 the University of Tübingen in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa and Madagascar. 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 numerous palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest Province, Mpumalanga, Gauteng, KwaZulu-Natal and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as a 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).

APPENDIX 2: HOOGLAND 1 WIND FARM, HOOGLAND 2 WIND FARM & HOOGLAND NORTHERN GRID CONNECTION PROJECT AREAS NEAR LOXTON - FOSSIL SITE DATA (APRIL – MAY 2021)

All GPS readings were taken in the field using a hand-held Garmin GPSmap 64s instrument. The datum used is WGS 84. Please note that:

- Locality data for South African fossil sites is *not* for public release, due to conservation concerns.
- The table does *not* represent all potential fossil sites within the project area but only those sites recorded during the 10-day field survey. The absence of recorded fossil sites in any area therefore does *not* mean that no fossils are present there.
- Details of fossil sites within sectors of the Grid Connection project area that overlap with the Nuweveld WEF project area have been tabulated elsewhere by Almond (2020a-c, 20201d).
- The detailed stratigraphic data for each site is provisional and has yet to be confirmed.
- **Proposed mitigation** for all sites with a **Proposed Field Rating IIIB or higher** is as follows: IF site lies < 20 m from final, approved footprint, pre-construction fossil recording and sampling by a professional palaeontologist is recommended in the pre-construction phase. Sites located > 20 m from the final, approved footprint do not require mitigation.
- No mitigation is recommended for fossil sites with a **Proposed Field Rating of IIIC**.

Loc.	GPS data	Comments
008	31°38'29.27"S 22°21'15.74"E	Farm Duikerfontein 1/5. Uppermost Abrahamskraal Fm (possibly equivalent to Karelskraal Member). Downwasted blocks of ripple cross-laminated channel sandstone with poorly-preserved reedy plant stem casts and / or invertebrate burrows on upper bedding surface. Proposed Field Rating IIIC Local Resource. No mitigation required.
020	31°36'29.68"S 22°21'17.67"E	Farm Duikerfontein RE/5. Uppermost Abrahamskraal Fm or basal Poortjie Member. Excavated large greyish to brownish-weathering, ripple cross-laminated channel sandstone blocks at roadside containing dispersed compression moulds of longitudinally-striated, unsegmented plant stems, microbial mat textures on rippled upper bedding planes associated with low-diversity invertebrate trace fossils (positive and negative epichnial burrows and furrows, possibly of undermat miners). Proposed Field Rating IIIC Local Resource. No mitigation recommended.
021	31°36'29.90"S 22°21'17.63"E	Farm Duikerfontein RE/5. Uppermost Abrahamskraal Fm or basal Poortjie Member. Excavated large greyish to brownish-weathering, ripple cross-laminated channel sandstone blocks at roadside. Microbial mat textures on current rippled upper bedding plane palaeosurface associated with low-diversity invertebrate trace fossils (positive and negative epichnial burrows and furrows, possibly of undermat miners). Proposed Field Rating IIIB Local Resource. Fossiliferous blocks to be carefully removed outside the project footprint in pre-construction phase if threatened by development (*e.g.* road widening).
022	31°36'46.06"S 22°20'49.95"E	Farm Duikerfontein RE/5. Uppermost Abrahamskraal Fm. *Equivocal* casts of tetrapod burrow casts within purple-brown, laminated siltstones immediately below channel sandstone base. Sole surfaces of downwasted channel sandstone blocks show moulds of mudstone intraclasts as well as poorly-preserved, washed-out intrastratal invertebrate burrows and possibly reedy plant stem casts. Proposed

Loc.	GPS data	Comments
		Field Rating IIIC Local Resource. No mitigation required.
023	31°36'47.27"S 22°20'48.11"E	Farm Duikerfontein RE/5. Uppermost Abrahamskraal Fm. Pale greyish, hackly-weathering wacke containing curved, smooth, pale-grey, mud-lined burrows *c*. 4 cm wide. Proposed Field Rating IIIC Local Resource. No mitigation required.
024	31°36'47.12"S 22°20'48.47"E	Farm Duikerfontein RE/5. Uppermost Abrahamskraal Fm. Fallen channel sandstone blocks with sole surfaces showing mudcrack infills and casts of comb-like sets of parallel and cross-cutting scratch marks on various scales (*cf Cruziana*) attributed to burrowing tetrapods active at the sandstone / mudrock interface. Proposed Field Rating IIIB Local Resource. Fossiliferous blocks to be carefully removed outside the project footprint in pre-construction phase if threatened by development (*e.g.* road widening).
027	31°36'18.72"S 22°19'46.15"E	Farm Duikerfontein RE/5. Uppermost Abrahamskraal Fm. Current crescents on flaggy channel sandstone sole surface, probably developed around reedy plant stems. Probable but still *equivocal* sandstone cast of tetrapod burrow enclosed within purple-brown mudrocks. Proposed Field Rating IIIC Local Resource. No mitigation required.
043	31°38'38.81"S 22°17'6.50"E	Farm Duikerfontein 2/1. Thick stream bank alluvial section with semi-consolidated, partially calcretised, orange-hued older alluvium containing calcretised rhizoliths / plant roots and / or burrows. Proposed Field Rating IIIC Local Resource. No mitigation required.
046	31°37'24.12"S 22°20'43.51"E	Farm Duikerfointein RE/5. Excellent sections through upper Abrahamskraal Formation mudrock and sandstone facies near farm dam. Fallen blocks of sandstone with pustulose microbial mat textures, meniscate-backfilled horizontal invertebrate burrows (*c*. 5 mm wide), probably of *Scoyenia* Ichnofacies. Proposed Field Rating IIIC Local Resource. No mitigation required.
052	31°40'4.34"S 22°23'45.39"E	Farm Slange Fontein RE/6. Gullied exposure of massive, mottled, purple-brown siltstones of Poortjie Member with isolated small (*c.* 10 cm long) dicynodont skull with articulated lower jaw. Proposed Field Rating IIIB Local Resource. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint.
063	31°40'1.69"S 22°29'4.39"E	Farm Slange Fontein RE/6. Good stream bank exposure of heterolithic, tabular-bedded, baked Poortjie Member succession to SE of farm dam. Thin-bedded purple-brown and grey green mudrocks with horizons of pedocrete concretions capped by thin, pale channel sandstone. Small dicynodont skull within grey-green siltstone. Proposed Field Rating IIIA Local Resource. No mitigation required.
064	31°40'3.55"S 22°29'4.96"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Small articulated dicynodont skull and some postcrania embedded within flattened sandstone burrow cast. Proposed Field Rating IIIA Local Resource. No mitigation required.
065	31°40'3.69"S 22°29'5.04"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Small dicynodont skull showing palate and skull roof, enclosed in sandstone burrow cast. Proposed Field Rating IIIA Local Resource. No mitigation required.
066	31°40'4.24"S 22°29'5.14"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Laterally-compressed small dicynodont skull. Proposed Field Rating IIIA Local Resource. No mitigation required.
067	31°40'4.14"S 22°29'5.00"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Small dicynodont skull. Proposed Field Rating IIIA Local Resource. No mitigation required.
068	31°40'4.13"S 22°29'5.03"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Several small dicynodont skulls embedded within purple-brown siltstone or calcrete concretions. Proposed Field Rating IIIA Local Resource. No mitigation required.
069	31°40'4.00"S 22°29'4.99"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Several small dicynodont skulls embedded within purple-brown siltstone or calcrete concretions. Proposed Field Rating IIIA Local Resource. No mitigation required.

Loc.	GPS data	Comments
070	31°40'4.33"S 22°29'5.13"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Several small dicynodont skulls embedded within purple-brown siltstone or weathered-out in float . Proposed Field Rating IIIA Local Resource. No mitigation required.
071	31°40'5.08"S 22°29'5.60"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Articulated skull of small dicynodont with tusks. Proposed Field Rating IIIA Local Resource. No mitigation required.
072	31°40'5.04"S 22°29'5.87"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Sandstone casts of several small helical tetrapod burrows within purple-brown mudrocks. Proposed Field Rating IIIA Local Resource. No mitigation required.
073	31°40'4.81"S 22°29'5.63"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Weathered-out. Calcretised helical tetrapod burrow cast . Proposed Field Rating IIIA Local Resource. No mitigation required.
074	31°40'4.59"S 22°29'5.24"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Well-preserved, articulated skull of small dicynodont within purple-brown mudrock. Proposed Field Rating IIIA Local Resource. No mitigation required.
084	31°43'28.30"S 22°27'52.92"E	Farm Slange Fontein RE/6. Dam overflow exposure of Hoedemaker Member grey-green to purple-brown mudrocks and fine-grained wackes with numerous (often cryptic) casts and moulds of straight to curved, horizontal to gently inclined tetrapod burrows of various scales (most 15-20 cm wide) – possibly a “warren” of small burrowing therapsids. Smoothed to bioturbated burrow floors common. Also smaller scale burrows of invertebrates. SEE NUWEVELD WEF Proposed Field Rating IIIA Local Resource. Recommended 10 m wide buffer around fossil site (already protected within water course). No mitigation required.
091	31°41'18.65"S 22°26'24.59"E	Farm Slange Fontein RE/6. Low ridge-like *koppie* with good exposure of Poortjie Member purple-brown and grey-green mudrocks with pale grey palaeocalcrete concretions, capped by purple-brown fine-grained sandstones. Numerous fragments of pale bone weathering out in surface float in erosion gullies. Also equivocal tetrapod burrows (pale greyish sandstone casts within purple-brown mudrock). Proposed Field Rating IIIB Local Resource. Material to be sampled if it falls within or close (< 10 m) to project footprint. No mitigation required.
092	31°41'18.24"S 22°26'24.31"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Fragmentary post-cranial bones of medium-sized tetrapod (perhaps a therocephalian). Proposed Field Rating IIIB Local Resource. Material to be sampled if it falls within or close (< 10 m) to project footprint. No mitigation required.
093	31°41'18.78"S 22°26'25.01"E	Farm Slange Fontein RE/6. Poortjie Member, as above. Greyish pedogenic palaeocalcrete concretion containing postcranial bone of medium-sized tetrapod. Proposed Field Rating IIIB Local Resource. Material to be sampled if it falls within or close (< 10 m) to project footprint. No mitigation required.
094	31°41'19.26"S 22°26'25.67"E	Farm Slange Fontein RE/6. Poortjie Member, as above. *Koppie* capping of purple-brown, fine-grained wackes containing disarticulated post-crania of medium-sized tetrapod (possible source of float material downslope).). Proposed Field Rating IIIB Local Resource. Material to be sampled if it falls within or close (< 10 m) to project footprint. No mitigation required.
095	31°41'19.19"S 22°26'25.50"E	Farm Slange Fontein RE/6. Poortjie Member mudrocks. Greyish pedogenic palaeocalcrete concretion containing postcranial bone of medium-sized tetrapod. Proposed Field Rating IIIB Local Resource. Material to be sampled if it falls within or close (< 10 m) to project footprint. No mitigation required.
097	31°41'19.04"S 22°26'23.91"E	Farm Slange Fontein RE/6. Poortjie Member mudrocks. Small tetrapod postcrania and possible jaw fragments in surface float. Proposed Field Rating IIIB Local Resource. Material to be sampled if it falls within or close (< 10 m) to project

Loc.	GPS data	Comments
		footprint. No mitigation required.
098	31°41'18.96"S 22°26'25.28"E	Farm Slange Fontein RE/6. Poortjie Member mudrocks. Small tetrapod postcrania within palaoecalcrete concretion. Proposed Field Rating IIIB Local Resource. Material to be sampled if it falls within or close (< 10 m) to project footprint. No mitigation required.
100	31°40'16.17"S 22°19'22.99"E	Farm Slange Fontein 1/6, probably Hoedemaker Member. Black, hackly-weathering hornfels in stream gulley exposure with isolated, baked skull of small carnivore – probably a therocephalian. Proposed Field Rating IIIB Local Resource. Material to be sampled if it falls within or close (< 10 m) to project footprint. No mitigation required.
101	31°42'17.95"S 22°17'46.97"E	Farm Elandsfontein 1/24. Poortjie Member. Purple-brown mudrocks and fine-grained sandstones with *Scoyenia* Ichnofacies trace fossil assemblages. Proposed Field Rating IIIC Local Resource. No mitigation required.
109	31°43'14.46"S 22°16'50.50"E	Farm Elandsfontein 1/24. Poortjie Member. Stream bank exposure of channel sandstones, basal mudflake breccias, bioturbated sandstone bed tops with vague horizontal invertebrate burrows. Proposed Field Rating IIIC Local Resource. No mitigation required.
116	31°43'52.92"S 22°15'56.79"E	Farm Elandsfontein 1/24. `Poortjie Member. Convex siltstone / fine-sandstone casts of tetrapod burrows (15-20 cm wide) as well as bioturbated, smooth burrow floors within massive, purple-brown siltstone facies. Proposed Field Rating IIIB Local Resource. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
117	31°43'52.83"S 22°15'57.47"E	As above. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
118	31°43'52.81"S 22°15'57.63"E	As above. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
119	31°43'52.00"S 22°15'59.70"E	As above. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
120	31°43'51.41"S 22°16'0.47"E	As above. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
121	31°43'51.39"S 22°16'1.54"E	As above. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
123	31°43'43.85"S 22°15'40.09"E	As above. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
124	31°43'42.40"S 22°15'41.14"E	As above. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
125	31°43'42.00"S 22°15'40.52"E	As above. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
127	31°43'41.03"S 22°15'25.81"E	Farm Elandsfontein 1/24. Poortjie Member. River bank exposure of purple-brown fine-grained sandstones with low diversity endichnial invertebrate traces. Proposed Field Rating IIIC Local Resource. No mitigation required.
130	31°43'2.10"S 22°15'16.23"E	Farm Elandsfontein 1/24. Poortjie Member. Low kranz of baked brownish, mottled bioturbated sandstone with several vertebrate burrow casts. Proposed Field Rating IIIB Local Resource. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
131	31°43'2.10"S 22°15'16.23"E	As above. Also narrower (< 1 cm wide), mud-infilled invertebrate horizontal burrows within baked sandstone. Proposed Field Rating IIIB Local Resource. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
134	31°43'24.15"S	Farm Drooge Onrust 1/22. Poortjie Member. Several isolated piece of unidentifiable

Loc.	GPS data	Comments
	22°19'10.84"E	rolled bone at surface on *vlaktes*. Proposed Field Rating IIIC Local Resource. No mitigation required. No mitigation required.
166	31°38'42.98"S 22°18'9.56"E	Farm Duikerfointein RE/5. Good stream bank sections through partially calcretised alluvial deposits in a doleritic area. Dense assemblages of calcretised rhizoliths and / or burrows. Proposed Field Rating IIIC Local Resource. No mitigation required.
168	31°38'31.86"S 22°19'13.33"E	Farm Duikerfontein 3/5. Small, lenticular, brown-weathering, massive channel sandstone body (uncertain stratigraphy – probably upper Abrahamskraal Fm but possibly Poortjie Mb) along escarpment edge. Longitudinally striated, elongate hollows (10-15 cm wide) on tops of sandstone blocks – *possibly* moulds of woody trunks (equivocal). Proposed Field Rating IIIC Local Resource. No mitigation required.
171	31°38'25.03"S 22°19'11.62"E	Farm Duikerfontein 3/5. Extensive exposures of Upper Abrahamskraal Fm or Poortjie Member (uncertain stratigraphy). V. *equivocal* tetrapod burrow casts within crumbly, purple-brown siltstones. Proposed Field Rating IIIC Local Resource. No mitigation required.
172	31°37'7.70"S 22°20'41.84"E	Farm Duikerfontein RE/5. Calcretised gritty older alluvial deposits exposed along Slangfontein se Rivier with dense assemblages of prominent-weathering, subvertical subcylindrical trace fossils – probably calcretised rhizoliths and / or burrows. .Proposed Field Rating IIIC Local Resource. No mitigation required – protected by riverine ecological buffer.
173	S31°43'28.4" E22°27'52.7"	Slange Fontein RE/6. Extensive baked, interbedded grey-green mudrock and fine-grained crevasse-splay wacke exposure downstream of concrete dam. *Probably upper* Poortjie Member rather than Hoedemaker Member. Numerous gently-inclined, straight or gently to strongly curved tetrapod burrows (*c*. 15-20 cm wide), most with smooth, furrowed or pustulose floors. Burrows preserved as concave-downward troughs or 3D, convex-upward burrow casts of siltstone within sandstone, or vice versa. Oblique scratch marks rarely preserved. Occasional broad, elliptical terminal chambers preserved. Also smaller scale (*c*. 1 cm wide) sinuous, longitudinally-ridged horizontal burrows. Field Rating IIIB Local Resource. No mitigation required.
176	31°42'33.91"S 22°15'3.68"E	Farm Elandsfontein 1/24. Poortjie Member. Fragments of pale bone and tooth within thin crevasse-splay sandstone. Proposed Field Rating IIIB Local Resource. No mitigation required. No mitigation required.
178	31°44'28.54"S 22°15'23.43"E	Farm Elandsfontein 1/24. Poortjie Member. Dusky purple-brown sandstone kranz with tetrapod burrow casts - extension of burrowed zone. Proposed Field Rating IIIB Local Resource. No mitigation required.
179	31°44'28.32"S 22°15'20.94"E	As above. Extensive outcrop area of purple-brown, medium-bedded sandstones with scattered tetrapod burrow casts. Proposed Field Rating IIIB Local Resource. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
181	31°45'10.89"S	Farm Elandsfontein 1/24. Good Poortjie Member exposures in dam overflow area. Isolated fragmentary bones within mudrock. Proposed Field Rating IIIC Local Resource. No mitigation required.
182	31°43'58.21"S 22°16'35.73"E	Farm Drooge Onrust 1/22. Poortjie Member. Incised stream gulley sections through dusky, massive, mottled purple-brown sandstone tetrapod burrow zone. Underlain by purple-brown siltstones with dispersed carbonate concretions. Proposed Field Rating IIIB Local Resource. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.

Loc.	GPS data	Comments
183	31°44'0.21"S 22°16'34.71"E	As above. Good tetrapod scratch burrow cast –chevron pattern of scratches on *upper* surface NB. Proposed Field Rating IIIB Local Resource. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
184	31°44'0.02"S 22°16'33.55"E	As above. Several tetrapod burrow casts. Proposed Field Rating IIIB Local Resource. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
185	31°43'59.98"S 22°16'33.49"E	As above. Gently inclined tetrapod burrow cast with scratches on dorsal surface. Smoothed burrow floors with invertebrate bioturbation. Proposed Field Rating IIIB Local Resource. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
186	31°43'59.93"S 22°16'33.25"E	As above. Wider tetrapod burrows (c. 25 cm across) with scratches on upper surface. Proposed Field Rating IIIB Local Resource. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
190	31°43'27.15"S 22°16'44.71"E	Farm Elandsfontein 1/24. Poortjie Member bedrocks in stream bed with several smooth tetrapod burrow floors showing intense bioturbation by small invertebrate burrows. Proposed Field Rating IIIB Local Resource. Protected by riverine ecological buffer. No mitigation required.
191	31°37'59.01"S 22°21'15.11"E	Farm Duikerfontein RE/5. Upper Abrahamskraal Formation. Well-developed bed of horizontally laminated pale yellowish tuffite with wave rippled top, small invertebrate burrows – suggested floodplain pond setting. Proposed Field Rating IIIC Local Resource. No mitigation required.
432	31°39'23.31"S 22°20'2.32"E	Boundary between Farm Slange Fontein 1/6 & Duikerfontein 1/5/ Stream bed and bank exposures of Poortjie Member purple-brown mudrocks and thin crevasse splay sandstones with low diversity trace fossil assemblages (sandstone casts of reedy plant stems, indeterminate invertebrate burrows). Proposed Field Rating IIIC Local Resource. No mitigation required – protected by ecological buffer along drainage lines.
433	31°39'25.56"S 22°20'2.05"E	Farm Slange Fontein 1/6. Poortjie Member sandstone blocks in stream bed with shallow pond margins palaeosurfaces showing small arthropod trackway (possibly insectan), adhesion warts, mud crack infills, small wavelength wave rippled surfaces. Proposed Field Rating IIIB Local Resource. Protected by riverine ecological buffer. No mitigation required.
434	31°39'26.04"S 22°20'1.47"E	As above. Well-developed small-scale wave rippled bed tops, compressions of equisetalean fern stems. Proposed Field Rating IIIC Local Resource. Protected by riverine ecological buffer. No mitigation required.
435	31°39'26.15"S 22°20'1.31"E	As above. Well-developed small-scale wave ripples (double-crested). *Possible* tetrapod undertracks impressed into wave-rippled palaeosurface. Dimpled surfaces, possible epichnial grooves. Proposed Field Rating IIIB Local Resource. Protected by riverine ecological buffer. No mitigation required.
437	31°40'5.04"S 22°18'25.89"E	Farm Duikerfontein 2/5. Thick sandy alluvium exposed in banks of stream gullies, calcretised below, with calcretised rhizoliths. Proposed Field Rating IIIC Local Resource. No recommended mitigation.
443	31°39'2.68"S 22°20'10.47"E	Farm Duikerfontein 1/5. Poortjie Member. Thin-bedded crevasse splay sandstones and mudrocks of distal floodplain / lacustrine facies with mudcrack infills, wave ripples, loaded sandstones, dense bedding plane assemblages of reedy plant stem casts, possible invertebrate trace fossils. Proposed Field Rating IIIC Local Resource. No recommended mitigation.
444	31°39'9.80"S 22°20'09.90"E	Farm Duikerfontein 1/5. Poortjie Member. Grey to purplish mottled siltstones with disarticulated skeletal remains of small carnivore, including serrated-edged tooth (>

Loc.	GPS data	Comments
		2cm long), postcrania. Proposed Field Rating IIIB Local Resource. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.
445	31°39'7.91"S 22°20'15.37"	Farm Duikerfontein 1/5. Poortjie Member. Float blocks of mudflake breccia with associated weathered pieces of robust tetrapod bones on underlying hillslopes. Proposed Field Rating IIIB Local Resource. Material to be sampled or recorded if it falls within or close (< 10 m) to project footprint. No mitigation required.

Fossil sites recorded during the palaeontological site visit for the Hoogland Northern Wind Farm Cluster (orange numbered dots, tabulated above) as well as those recorded during previous site visits to the Nuweveld Wind Farm project area (yellow, pale orange and green numbered dots, tabulated in Almond 2020a-c, 2021) are mapped on Google Earth© satellite images in Figures A2.1 to A2.3 below.

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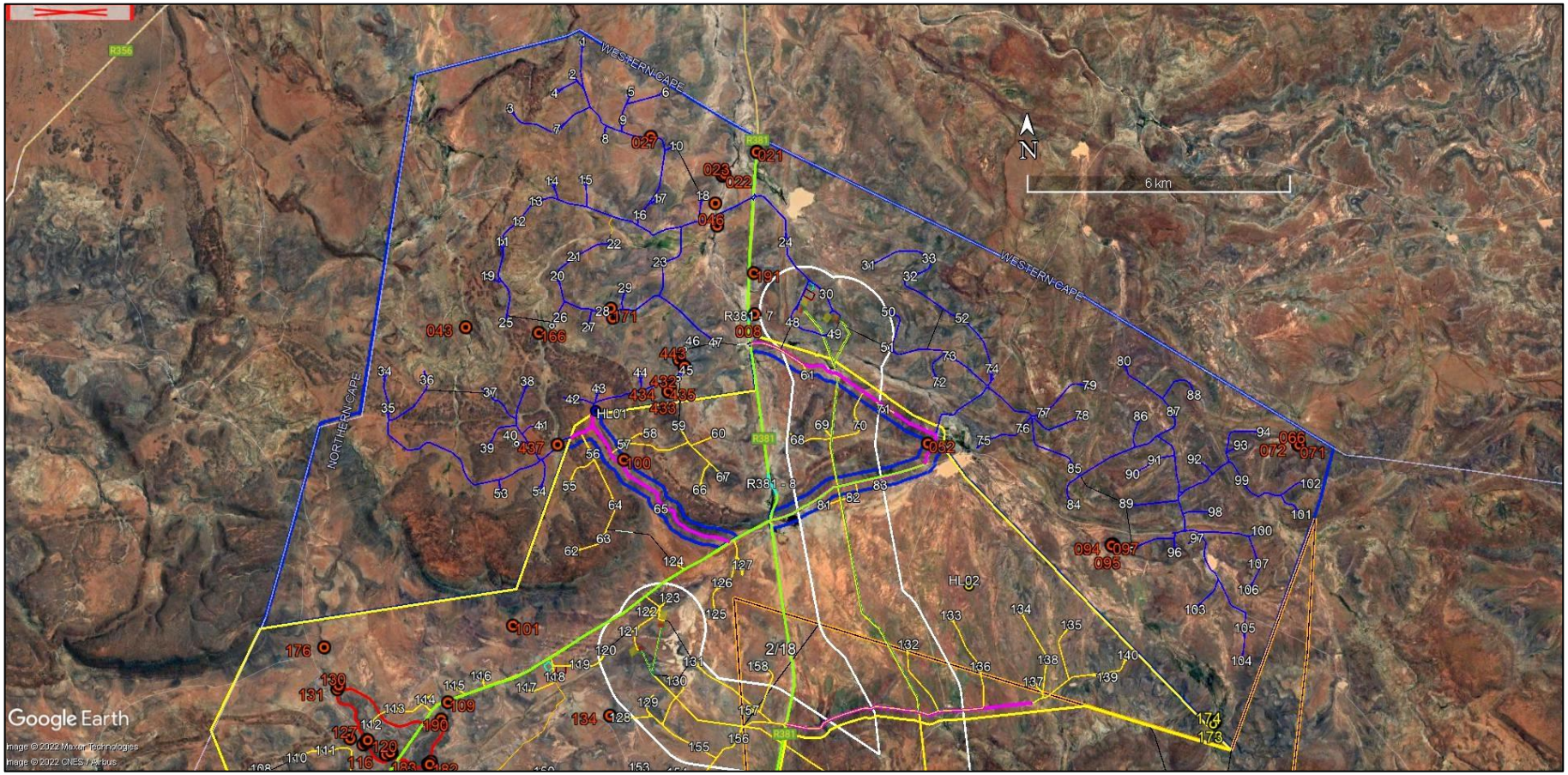

Figure A2.1: Google Earth© satellite image showing the location of the new fossil sites in relation to the proposed layout of the Hoogland 1 Wind Farm infrastructure (blue polygon) and the Hooglansd Northern Grid Connection (white shape). Also shown are *selected* key elements of the wind farm infrastructure layout including: wind turbine positions (small numbered blue dots), access roads (thin blue lines), on-site substations and BESS (small yellow rectangles), site camp and batching plant (pale blue rectangle) and laydown area (dark red rectangle). None of the recorded sites lies within or close to (≤ 20 m) the footprint of the proposed WEF layout and therefore no mitigation of these sites is necessary. See also

in main text of the report.

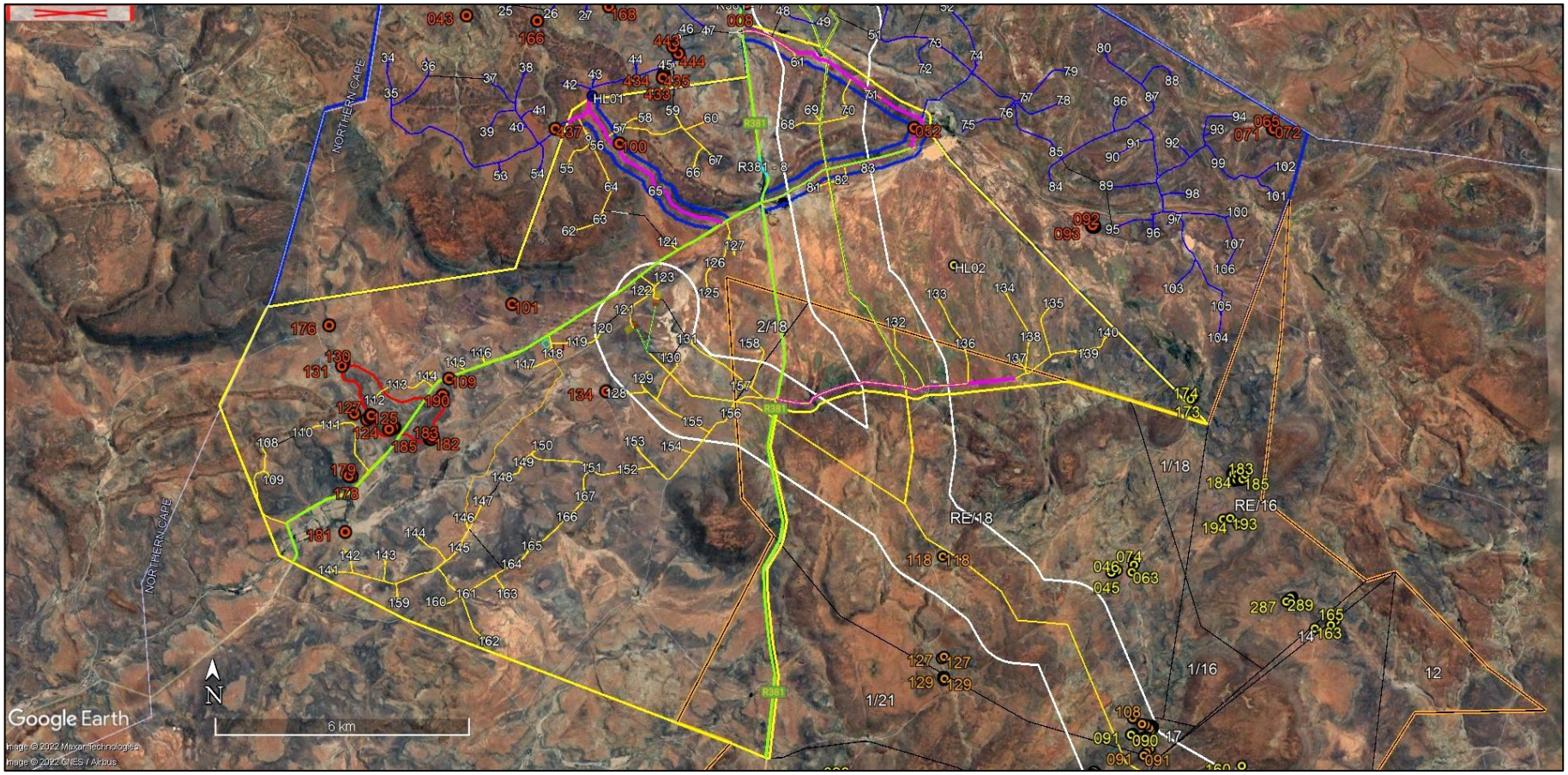

Figure A2.2: Google Earth© satellite image showing the location of the new fossil sites in relation to the proposed layout of the Hoogland 2 Wind Farm infrastructure (yellow polygon) and the Hooglansd Northern Grid Connection (white shape). Also shown are *selected* key elements of the wind farm infrastructure layout including: wind turbine positions (small numbered blue dots), access roads (thin blue lines), on-site substations and BESS (small yellow rectangles), site camp and batching plant (pale blue rectangle) and laydown area (dark red rectangle). None of the recorded sites lies within or close to (≤ 20 m) the footprint of the proposed WEF layout and therefore no mitigation of these sites is necessary. See also Figure 6-2 in main text of the report.

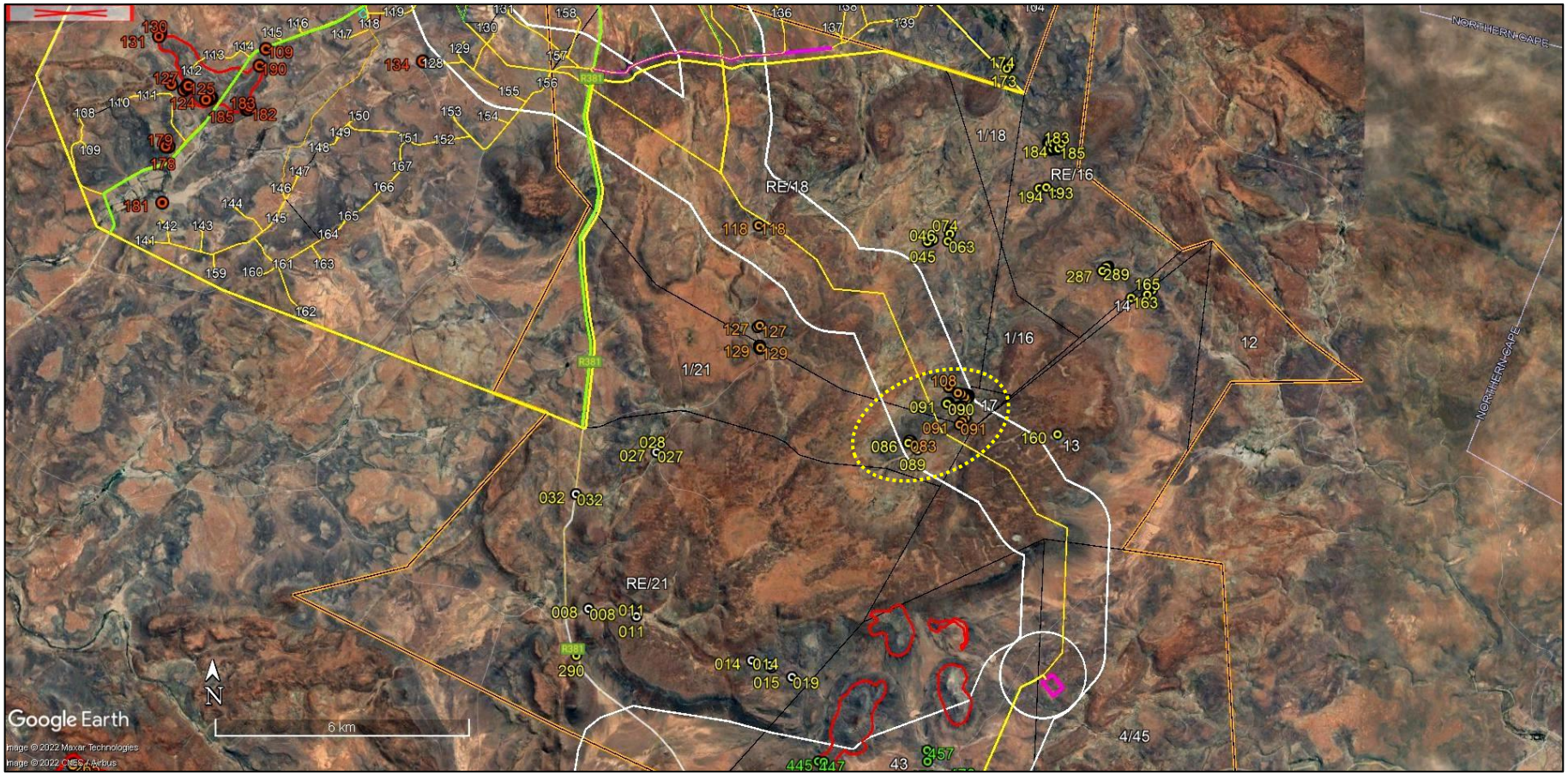

Figure A2.3: Google Earth© satellite image of the southern sector of the Hoogland Northern Grid Connection project area (white shape), much of which overlaps with the Nuweveld Wind Farm project area (orange polygon), and adjacent portions of the Hoogland 2 Wind Farm project area (yellow polygon) showing the location of new fossil sites. None of the recorded sites lies within or close to (≤ 20 m) the footprint of the proposed WEF layout and therefore no mitigation of these sites is necessary. Pink rectangle = Nuweveld Collector Switching Station (assessed separately). Small red afreas in the south = Very High sensitiivty areas identified within the Nuweveld WEF project area. See also Figure 6.3 in the text for more detail of the fossil-rich area enclosed by the yellow dotted ellipse.

APPENDIX 3: PALAEONTOLOGICAL HERITAGE SITE SENSITIVITY VERIFICATION: HOOGLAND 1 WIND FARM, HOOGLAND 2 WIND FARM & HOOGLAND NORTHERN GRID CONNECTION, WESTERN CAPE

SUMMARY

The Medium to Very High Palaeosensitivity provisionally proposed by the DFFE screening tool for the combined project area for the Hoogland Northern Cluster of wind farms and associated Northern Grid Connection is *contested* here. Based on desktop analysis as well as a ten-day site visit to the project area, it is concluded that this is largely of Low Palaeosensitivity with sparse, small and largely unpredictable sites of High to Very High Palaeosensitivity.

INTRODUCTION

Red Cap Energy (Pty) Ltd ('Red Cap') is proposing to develop four wind farms and associated grid connections (together known as the Hoogland Projects) in an area located between Loxton and Beaufort West in the Northern and Western Cape Provinces (Figure A3.1). Each wind farm would have a targeted nameplate capacity of up to a maximum of 420 MW and would involve the construction of no more than 60 turbines.

The Hoogland 1 Wind Farm and Hoogland 2 Wind Farm project areas are located to the north closer to Loxton and form the Northern Cluster of wind farms which will share a grid connection, named the Hoogland Northern Grid Connection. The Grid Connection will comprise a 132 kV overhead power line which will connect the Hoogland Wind Farms to the Nuweveld Collector Substation on Red Cap's adjacent Nuweveld Wind Farms Project. Power will then be fed into the Eskom Droërivier Substation located near Beaufort West *via* the proposed Nuweveld Gridline.

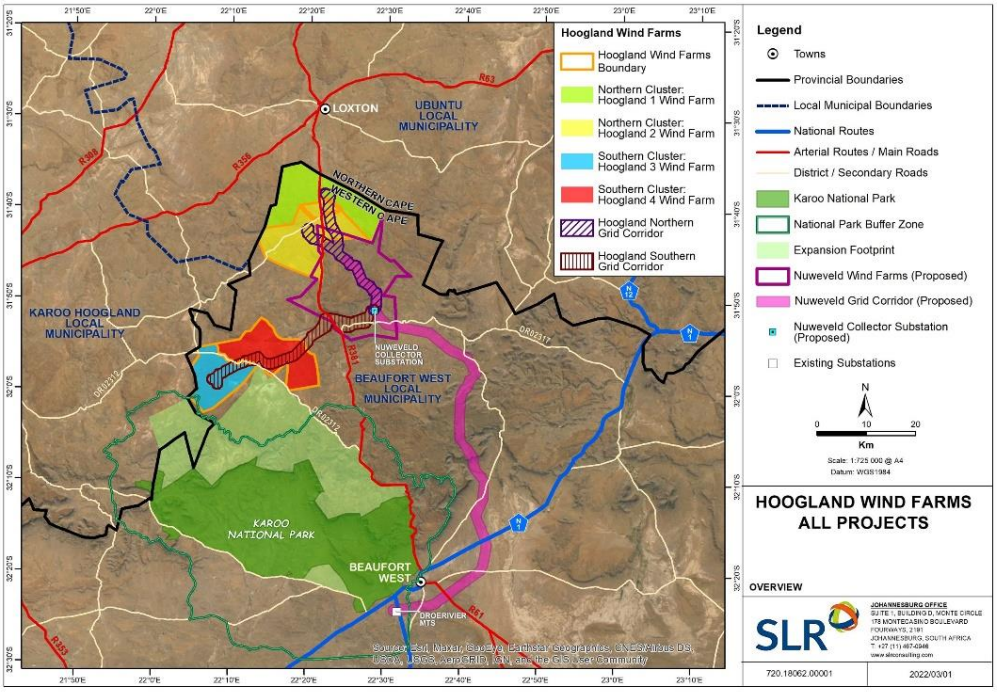

Figure A3.1: Locality Map of the proposed Hoogland Wind Farms and associated Grid Corridor showing the adjacent Nuweveld Wind Farms and its Grid Connection (part of six separate application processes).

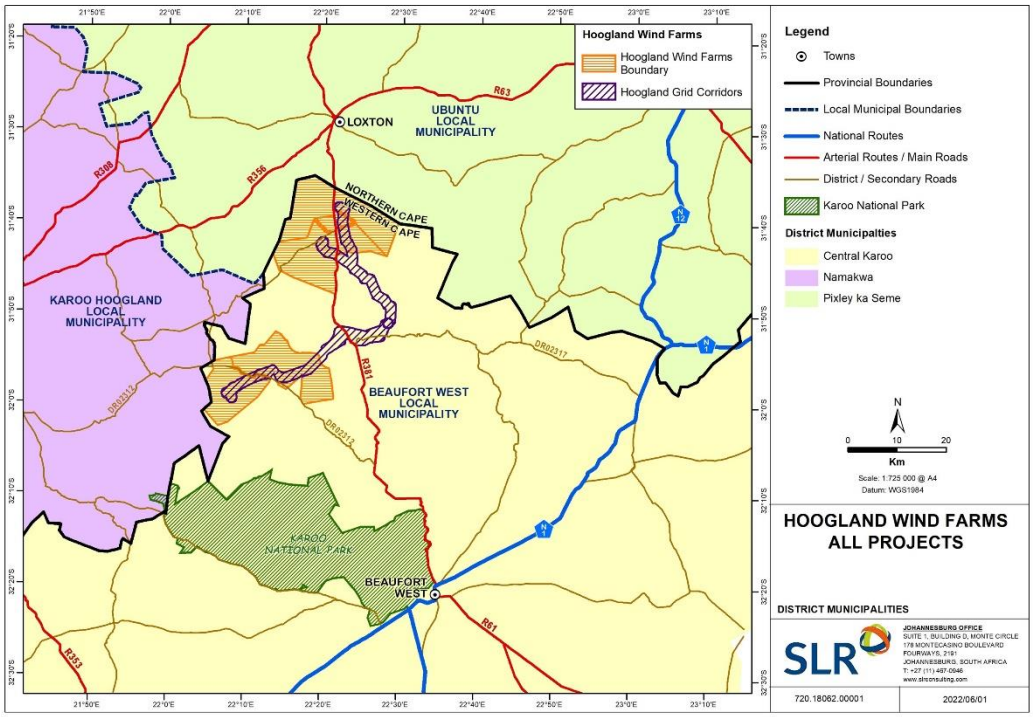

Figure A3.2: Map showing the location of the Proposed Hoogland Wind Farms and associated Grid Connection Corridors (part of 6 separate application processes). The Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and associated Hoogland Northern Grid Connection lie within the Central Karoo District Municipality of the Western Cape Province.

In terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations (4 December 2014, Government Notice (GN) R982, R983, R984 and R985, as amended), various aspects of the proposed development may have an impact on the environment and are considered to be listed activities. These activities require authorisation from the National Competent Authority (CA), namely the Department of Forestry, Fisheries and the Environment (DFFE), prior to the commencement thereof.

In accordance with GN 320 and GN 1150 (20 March 2020)[2] of the NEMA EIA Regulations of 2014, prior to commencing with a specialist assessment, a site sensitivity verification must be undertaken to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool). Dr John Almond (*Natura Viva* cc) has been commissioned to verify the palaeontological heritage sensitivity of the Hoogland Wind Farm and Grid Connection project sites under these specialist protocols.

The scope of this report is the Hoogland 1 Wind Farm and Hoogland 2 Wind Farm (the Northern Wind Farm Cluster) as well as the Hoogland Northern Grid Connection applications. Even though these are three separate applications they will be considered in the same specialist site sensitivity verification report, given their very similar geological and palaeontological heritage character.

[2] [2] GN 320 (20 March 2020): Procedures for The Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation

1. SITE SENSITIVITY VERIFICATION METHODOLOGY

The present palaeontological site sensitivity verification is based on:

(1) A desktop review of relevant 1:50 000 scale topographic maps, Google Earth© satellite imagery, published geological and palaeontological literature, including 1:250 000 geological maps (3122 Victoria West) and the relevant sheet explanations (Le Roux & Keyser 1988) as well as recent palaeontological heritage assessments (PIAs) in the Upper Karoo region near Loxton by the author (*viz*: Nuweveld Wind Farm projects, Hoogland 3 Wind Farm and Hoogland 4 Wind Farm);

(2) The author's field experience with the formations concerned and their palaeontological heritage; and

(3) A ten-day field assessment of the combined Hoogland 1 Wind Farm, Hoogland 2 Wind Farm project areas during the period 9-19 April as well as 14 May 2021. This study also makes reference to field data for sectors of the Northern Grid Connection corridor that overlap the project area of the Nuweveld Wind Farm cluster and that were previously assessed by Almond (2020a-c, 2021).

OUTCOME OF SITE SENSITIVITY VERIFICATION

Provisional palaeosensitivity mapping using the DFFE Screening Tool suggests that the majority of the combined Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection project area is of Very High palaeosensitivity based on the widespread occurrence here of Permian age sedimentary bedrocks of the Lower Beaufort Group (Karoo Supergroup) (Figs. A3.3 & A3.4). Areas underlain by thick Late Caenozoic alluvium are assigned a Medium palaeosensitivity while dolerite intrusions (igneous rocks) are not sensitive at all.

The ten-day palaeontological site visit indicated that, in practice, well-preserved fossils of scientific and conservation interest are remarkably rare within the Lower Beaufort Group bedrocks within Hoogland project area as a whole. This is attributed to (a) poor levels of bedrock exposure associated with generally low relief and pervasive cover by largely unfossiliferous superficial sediments; (b) extensive dolerite intrusion which has "sterilized" large volumes of potentially fossiliferous bedrocks through thermal metamorphism, leaching and secondary mineralisation, while the large dolerite outcrop areas in the uplands are completely fossil-free; (c) highly impoverished fossil biotas within the upper Abrahamskraal – Poortjie Member stratigraphic interval that are associated with the catastrophic end Middle Permian Mass Extinction Event of ~260 Ma. Only two limited areas of High Sensitivity, featuring concentrations of small vertebrate skeletal remains and tetrapod burrows, have been identified here so far. The pervasive Late Caenozoic cover sediments, including alluvium, are also largely unfossiliferous, mainly yielding low diversity trace fossils of widespread occurrence and limited scientific or conservation value.

Based on this recent field data as well as desktop analysis, it is concluded that the combined Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Hoogland Northern Grid Connection project areas is effectively of Low Palaeosensitivity overall. The presence of additional small, hitherto unrecorded pockets of High to Very High palaeosensitivity cannot be discounted, however. The provisional DFFE site sensitivity mapping is accordingly *contested* here.

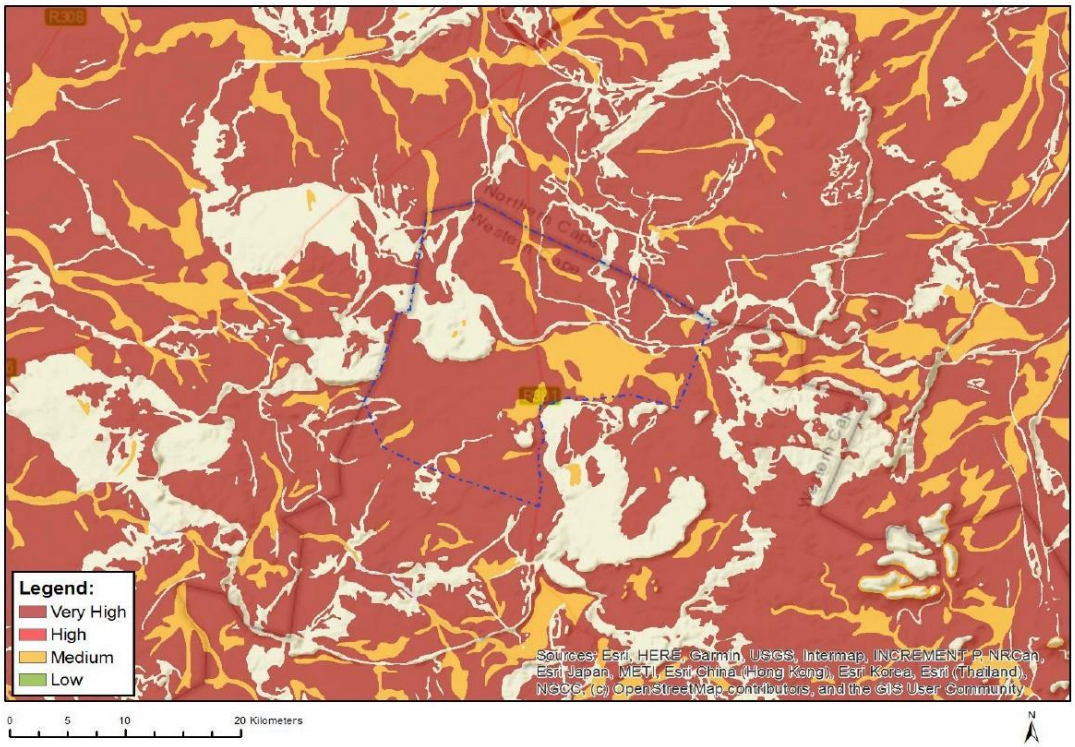

Figure 3: Palaeosensitivity of the Hoogland Wind Farm Northern Cluster project area (blue polygon) based on the DFFE Screening Tool (Abstracted from screening report provided by SLR Consulting).

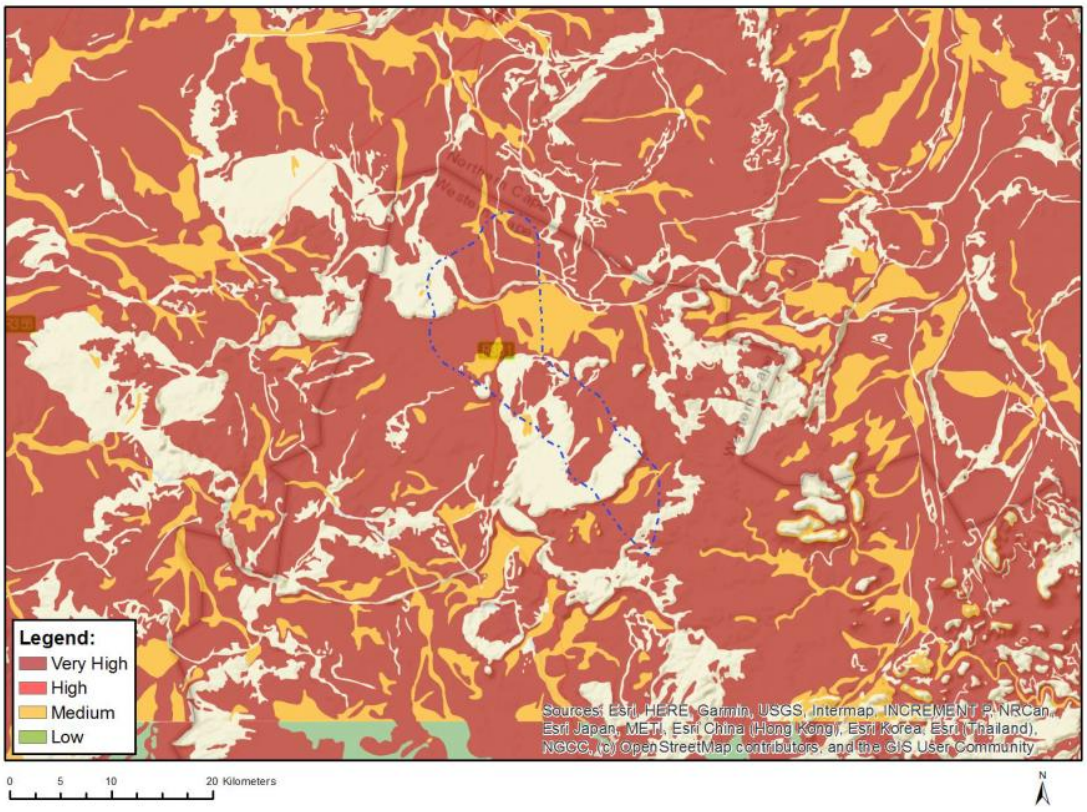

Figure 4: Palaeosensitivity of the Hoogland Wind Farm Northern Grid Connection project area (blue polygon) based on the DFFE Screening Tool (Abstracted from screening report provided by SLR Consulting).

PALAEONTOLOGICAL CHANCE FOSSIL FINDS PROTOCOL

<table>
<tr><th colspan="3">HOOGLAND NORTHERN WIND FARM CLUSTER and GRID CONNECTION south of Loxton, Western Cape</th></tr>
<tr><td>Province & region:</td><td colspan="2">Wind Farms and Grid Connections: Western Cape (Central Karoo District): Beaufort West Local Municipality
Offsite watercourse crossing upgrades applicable to the Northern Wind Farm Cluster only: Northern Cape (Namakwa and Pixley Ka Seme Districts): Karoo Hoogland and Ubuntu Local Municipalities</td></tr>
<tr><td rowspan="2">Responsible Heritage Resources Agency</td><td colspan="2">Western Cape:
Heritage Western Cape (Contact details: Heritage Western Cape. 3rd Floor Protea Assurance Building, 142 Longmarket Street, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 021 483 5959 Email: ceoheritage@westerncape.gov.za)</td></tr>
<tr><td colspan="2">Northern Cape:
SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Abrahamskraal & Teekloof Formations (Lower Beaufort Group), Late Caenozoic alluvium</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Fossil vertebrate bones, teeth, trace fossils including burrows, trackways, petrified wood, plant-rich beds in the Lower Beaufort Group bedrocks. Fossil mammal bones, teeth, horn cores, freshwater molluscs, plant material in Late Caenozoic alluvium.</td></tr>
<tr><td rowspan="5">ECO/ESO 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 Agency 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 Agency fo 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 Agency and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Agency, 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 Agency</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 Agency. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Agency minimum standards.</td></tr>
</table>

APPENDIX 5: PALAEONTOLOGICAL ASSESSMENT OF STREAM CROSSINGS

Refer to Separate Report

APPENDIX 6: SAHRA INTERIM COMMENT

Hoogland 1 Wind Farm and Hoogland 2 Wind Farm between Loxton and Beaufort West, Western and Northern Cape Provinces

Our Ref:

an agency of the
Department of Arts and Culture

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South African Heritage Resources Agency | 111 Harrington Street | Cape Town
P.O. Box 4637 | Cape Town | 8001
www.sahra.org.za

Enquiries: Natasha Higgitt
Tel: 021 462 4502
Email: nhiggitt@sahra.org.za
CaseID: 18203

Interim Comment

In terms of Section 38(3), 38(8) of the National Heritage Resources Act (Act 25 of 1999)

Attention: SLR Consulting (South Africa) (Pty) Ltd

Red Cap Energy (Pty) Ltd ('Red Cap') is proposing to develop four Wind Farms and associated grid connections (together referred to as the Hoogland Project) in an area located between Loxton and Beaufort West in the Northern and Western Cape Provinces. Hoogland 1 and 2 are located to the north closer to Loxton and form the Northern Cluster of Wind Farms that will share a grid connection named the Hoogland Northern Grid Connection. Hoogland 3 and 4 are located closer to Beaufort West and comprise the Southern Cluster which will similarly share a separate grid connection, named the Southern Grid Connection This application is for the Hoogland Northern Wind Farm Cluster (Hoogland 1 Wind Farm and Hoogland 2 Wind Farm), which is subject to a Scoping and EIA process. Even though these are two separate applications they will be considered in the same Scoping Report. The Department of Forestry, Fisheries and the Environment (DFFE) has granted Red Cap permission to combine the two Wind Farms into one Environmental Authorisation Application processes under Regulation 11 (1) of GN R. 982. It is proposed that each wind farm will comprise of up to 60 turbines with a targeted nameplate generation capacity of a maximum of 420MW. The entire footprint for each respective wind farm falls within the Western Cape Province, however, some watercourse crossing upgrades on existing roads fall within the Northern Cape and are under the jurisdiction of SAHRA. It should however be noted that the specialist has confirmed they have no heritage significance and do not warrant an assessment.

SLR Consulting (South Africa) (Pty Ltd) has been appointed by Red Cap Hoogland 1 (Pty) Ltd and Red Cap Hoogland 2 (Pty) Ltd to conduct an Environmental Authorisation (EA) Application for the proposed Red Cap Hoogland Northern Wind Farm Cluster between Loxton, Northern Cape Province and Beaufort West, Western Cape Province (Hoogland 1: 14/12/16/3/3/2/2147 and Hoogland 2: 14/12/16/3/3/2/2146).

A draft Scoping Report (DSR) has been submitted in terms of the National Environmental Management Act, 1998 (NEMA) and the 2017 NEMA Environmental Impact Assessment (EIA) Regulations. The proposed development will include the construction of 94 and 82 turbines respectively for each facility including infrastructure such as underground cables, on-site substation, battery energy storage system, turbine foundations, transformers at each turbine, workshop and laydown areas, hardstands at each turbine, operation and maintenance buildings, office stores, service and access roads, stormwater infrastructure, gates,

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temporary site camps, concrete batching plant, crane boom and blade laydown areas. It must be noted that the majority of both developments is located in the Western Cape. The only development activities located in the Northern Cape include stream crossing upgrades, which are shared activities for both EA applications. This comment pertains only to the stream crossing upgrades located within the Northern Cape Province.

Natura Viva CC and ASHA Consulting have been appointed to provide heritage specialist input as required by section 24(4)b(iii) of NEMA and section 38(8) of the National Heritage Resources Act, Act 25 of 1999 (NHRA).

Almond, J. E. 2022. Proposed Hoogland Wind Farms and Grid Connection Project Northern Cluster: Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Associated Hoogland Northern Grid Connection, Western Cape Province: Palaeontological Heritage.

The proposed development area is underlain by the lower Beaufort Group of Middle to Late Permian age. Several fossils were identified within streams in the Western Cape section of the development area which include several skulls and post-cranial skeletal remains of tetrapods, numerous tetrapod burrow casts and a low diversity of trace fossils which were concluded to be of limited scientific or conservation value. The area in which the stream crossings are located were not assessed as part of the PIA as these activities were added after the completion of the PIA.

Recommendations provided in the report include the following:

- The final, authorised layout of the Hoogland Wind Farm and Grid Connection projects should be crosschecked against the available fossil database and other relevant resources (e.g. satellite imagery, geological maps) by the palaeontological specialist who should make recommendations for pre-construction phase mitigation, if any proves necessary. This might entail, for example, focused palaeontological walk-downs of selected, previously un-surveyed and potentially sensitive sectors of the project footprint with judicious sampling or collection of threatened fossil material of scientific and / or conservation value;
- Application of Chance Fossil Finds Protocol by the ECO and palaeontological specialist during the construction phase (See Appendix 4).

Orton, J. 2022. Heritage Impact Assessment: Proposed Hoogland 1 Wind Farm and Hoogland 2 Wind Farm, Beaufort West Magisterial District, Western Cape.

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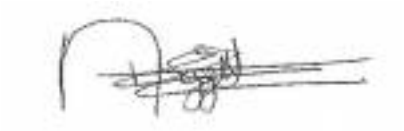
Only the results of the survey at the stream crossings will be discussed here. One of the stream crossings includes a concrete bridge dated to 1952, making the bridge 70 years old and thus protected by section 34 of the NHRA. The report noted the bridge as a heritage resource of very low cultural significance and required no further study.

Interim Comment

The SAHRA Archaeology, Palaeontology and Meteorites (APM) Unit requests that a field based PIA of the stream crossings in the Northern Cape section be conducted as part of the EIA phase as fossils have been identified in streams in the Western Cape section of the development. Further comments will be issued upon receipt of the draft EIA documents inclusive of appendices and updated PIA.

Should you have any further queries, please contact the designated official using the case number quoted above in the case header.

Yours faithfully



Natasha Higgitt
Heritage Officer
South African Heritage Resources Agency

Phillip Hine
Manager: Archaeology, Palaeontology and Meteorites Unit
South African Heritage Resources Agency

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Department of Arts and Culture

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Enquiries: Natasha Higgitt
Tel: 021 462 4502
Email: nhiggitt@sahra.org.za
CaseID: 18203

Date: Thursday May 26, 2022

ADMIN:
Direct URL to case: https://sahris.sahra.org.za/node/594209
(DEA, Ref: To be allocated)

.

NATURA VIVA cc
Palaeontological Impact Assessments & Heritage Management, Natural History Education, Tourism, Research

Attn: **Ms Natasha Higgitt**
SAHRA
111 Harrington Street
Cape Town

Date: **3 June 2022**

NORTHERN CAPE PALAEONTOLOGICAL HERITAGE INPUT:

Hoogland 1 Wind Farm and Hoogland 2 Wind Farm between Loxton and Beaufort West, Western and Northern Cape Provinces

Dear Ms Higgitt,

I have been forwarded a copy of your Interim Comment of 26 May 2022 on these renewable energy projects (SAHRA Case ID: 18203).

I note that you are requesting that a field based PIA of the stream crossings in the Northern Cape section of the project footprint be conducted as part of the EIA phase for these developments.

As you have noted, in my PIA reports for these WEFs I have recommended a focused specialist palaeontological walk-down of selected, potentially sensitive sectors of the WEF footprints in the pre-construction phase. This would include stream / river crossings where these have not already been surveyed. In the case of the particular Northern Cape stream / river crossings in question, I understand from my colleague Dr Jayson Orton, who has been on site, that these crossings are unlikely to have good exposure of Beaufort Group bedrock or older consolidated alluvium - the primary targets of fossil surveying in the region, so I would not expect any issues here (I am appending here a very helpful tabulation of the relevant N Cape sites, none of which shows potentially vulnerable sedimentary bedrock exposures, which has been kindly provided by Dr Orton).

The developer, RedCap and EAP SLR have already gone the extra mile in promoting PIA input into the Hoogland WEF projects, in contrast to several other Karoo WEF developers and EAPs. I am reluctant to complicate the EIA process when I do not feel that a separate palaeontological site visit is likely to add value to the palaeontological database or fossil heritage conservation at this stage. For these reasons – and also due to added expense *plus* time constraints – my preference would therefore be stay with my original recommendations rather than have to make a separate trip and PIA report for the EIA phase Perhaps we could rather reinforce the PIA recommendations to specify palaeontological walk downs of stream / river crossings in the N. Cape in the pre-construction phase.

Best wishes,

John E. Almond

John Almond (Palaeontologist), *Natura Viva* cc

***NATURA VIVA cc* (Reg. No. 2000/019296/23)**
Members: Dr J.E. Almond (British)(Managing), M.L. Tusenius
76 Breda Park, Oranjezicht CAPE TOWN 8001, RSA
Tel: +27 (21) 462 3622 E-mail: naturaviva@universe.co.za

Table 1: Watercourse Crossing Upgrades and Temporary Bypass Road.

Watercourse Crossing (No. & road)	Current Situation	Province and Municipality	Coordinates (North)	Coordinates (South)	Road reserve Landowners	Photograph
1. DR02314	Drift	Northern Cape, Namakwa DM, Karoo Hoogland LM	31° 46' 37" 22° 4' 22"	31° 47' 2" 22° 4' 26"	Northern Cape Government: Department of Roads and Public Works	
2 & 3. DR02314	Low water cement drift with culverts	Northern Cape, Namakwa DM, Karoo Hoogland LM	31° 48 ' 36" 22° 5 ' 24"	31° 49' 43" 22° 5' 42"	Northern Cape Government: Department of Roads and Public Works	 
4. DR02314	Low water cement drift with blocked culverts	Northern Cape, Namakwa DM, Karoo Hoogland LM; and Western Cape, Central Karoo DM, Beaufort West LM	31° 52' 49" 22° 5' 21"	31° 53' 2" 22° 5' 20"	Northern Cape Government: Department of Roads and Public Works; and Western Cape Government: Department of Transport and Public Works	
5. R381	Concrete bridge (dated 1952)	Northern Cape, Pixley ka Seme DM, Ubuntu LM	31° 32 ' 1" 22° 20 ' 27"	31° 32' 23" 22° 20' 19"	Northern Cape Government: Department of Roads and Public Works	

Watercourse Crossing (No. & road)	Current Situation	Province and Municipality	Coordinates (North)	Coordinates (South)	Road reserve Landowners	Photograph
						
6. R381	Concrete bridge (undated)	Northern Cape, Pixley Ka Seme DM, Ubuntu LM	31° 33' 17" 22° 21' 2"	31° 33' 33"; 22° 21' 7"	Northern Cape Government: Department of Roads and Public Works	
7. R381	Washed away, with recent repairs flood-damaged again in 2022	Western Cape, Central Karoo DM, Beaufort West LM	31° 38' 28" 22° 21' 10"	31° 38' 35" 22° 21' 10"	Western Cape Government: Department of Transport and Public Works	
8. R381	Concrete bridge with blocked culverts	Western Cape, Central Karoo DM, Beaufort West LM	31° 40' 27" 22° 21' 27"	31° 40' 42" 22° 21' 34"	Western Cape Government: Department of Transport and Public Works	
N1 Bypass	No existing road reserve but gravel tracks present over much of the alignment. Also includes a watercourse crossing upgrade: Low water cement drift with blocked culverts	Western Cape, Central Karoo DM, Beaufort West LM	32° 19' 56" 22° 35' 7"	32° 21' 41" 22° 32' 45"	Farm 185 & RE Erf 5372: Beaufort West Local Municipality	Previously assessed in Orton (2021b, 2021c, 2021d).

Hoogland 1 Wind Farm and Hoogland 2 Wind Farm between Loxton and Beaufort West, Western and Northern Cape Provinces

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Tel: 021 462 4502
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CaseID: 18203

Interim Comment

In terms of Section 38(3), 38(8) of the National Heritage Resources Act (Act 25 of 1999)

Attention: SLR Consulting (South Africa) (Pty) Ltd

Red Cap Energy (Pty) Ltd ('Red Cap') is proposing to develop four Wind Farms and associated grid connections (together referred to as the Hoogland Project) in an area located between Loxton and Beaufort West in the Northern and Western Cape Provinces. Hoogland 1 and 2 are located to the north closer to Loxton and form the Northern Cluster of Wind Farms that will share a grid connection named the Hoogland Northern Grid Connection. Hoogland 3 and 4 are located closer to Beaufort West and comprise the Southern Cluster which will similarly share a separate grid connection, named the Southern Grid Connection This application is for the Hoogland Northern Wind Farm Cluster (Hoogland 1 Wind Farm and Hoogland 2 Wind Farm), which is subject to a Scoping and EIA process. Even though these are two separate applications they will be considered in the same Scoping Report. The Department of Forestry, Fisheries and the Environment (DFFE) has granted Red Cap permission to combine the two Wind Farms into one Environmental Authorisation Application processes under Regulation 11 (1) of GN R. 982. It is proposed that each wind farm will comprise of up to 60 turbines with a targeted nameplate generation capacity of a maximum of 420MW. The entire footprint for each respective wind farm falls within the Western Cape Province, however, some watercourse crossing upgrades on existing roads fall within the Northern Cape and are under the jurisdiction of SAHRA. It should however be noted that the specialist has confirmed they have no heritage significance and do not warrant an assessment.

SLR Consulting (South Africa) (Pty Ltd) has been appointed by Red Cap Hoogland 1 (Pty) Ltd and Red Cap Hoogland 2 (Pty) Ltd to conduct an Environmental Authorisation (EA) Application for the proposed Red Cap Hoogland Northern Wind Farm Cluster between Loxton, Northern Cape Province and Beaufort West, Western Cape Province (Hoogland 1: 14/12/16/3/3/2/2147 and Hoogland 2: 14/12/16/3/3/2/2146).

A draft Scoping Report (DSR) has been submitted in terms of the National Environmental Management Act, 1998 (NEMA) and the 2017 NEMA Environmental Impact Assessment (EIA) Regulations. The proposed development will include the construction of 94 and 82 turbines respectively for each facility including infrastructure such as underground cables, on-site substation, battery energy storage system, turbine foundations, transformers at each turbine, workshop and laydown areas, hardstands at each turbine, operation and maintenance buildings, office stores, service and access roads, stormwater infrastructure, gates,

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temporary site camps, concrete batching plant, crane boom and blade laydown areas. It must be noted that the majority of both developments is located in the Western Cape. The only development activities located in the Northern Cape include stream crossing upgrades, which are shared activities for both EA applications. This comment pertains only to the stream crossing upgrades located within the Northern Cape Province.

Natura Viva CC and ASHA Consulting have been appointed to provide heritage specialist input as required by section 24(4)b(iii) of NEMA and section 38(8) of the National Heritage Resources Act, Act 25 of 1999 (NHRA).

Almond, J. E. 2022. Proposed Hoogland Wind Farms and Grid Connection Project Northern Cluster: Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and Associated Hoogland Northern Grid Connection, Western Cape Province: Palaeontological Heritage.

The proposed development area is underlain by the lower Beaufort Group of Middle to Late Permian age. Several fossils were identified within streams in the Western Cape section of the development area which include several skulls and post-cranial skeletal remains of tetrapods, numerous tetrapod burrow casts and a low diversity of trace fossils which were concluded to be of limited scientific or conservation value. The area in which the stream crossings are located were not assessed as part of the PIA as these activities were added after the completion of the PIA.

Recommendations provided in the report include the following:

- The final, authorised layout of the Hoogland Wind Farm and Grid Connection projects should be crosschecked against the available fossil database and other relevant resources (e.g. satellite imagery, geological maps) by the palaeontological specialist who should make recommendations for pre-construction phase mitigation, if any proves necessary. This might entail, for example, focussed palaeontological walk-downs of selected, previously unsurveyed and potentially sensitive sectors of the project footprint with judicious sampling or collection of threatened fossil material of scientific and / or conservation value;
- Application of Chance Fossil Finds Protocol by the ECO and palaeontological specialist during the construction phase (See Appendix 4).

Orton, J. 2022. Heritage Impact Assessment: Proposed Hoogland 1 Wind Farm and Hoogland 2 Wind Farm, Beaufort West Magisterial District, Western Cape.

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Only the results of the survey at the stream crossings will be discussed here. One of the stream crossings includes a concrete bridge dated to 1952, making the bridge 70 years old and thus protected by section 34 of the NHRA. The report noted the bridge as a heritage resource of very low cultural significance and required no further study.

In an Interim Comment issued on the 26/05/2022, SAHRA requested that a field based PIA of the stream crossings in the Northern Cape section be conducted as part of the EIA phase as fossils have been identified in streams in the Western Cape section of the development. A letter of response to the Interim Comment has been uploaded to the Heritage Report file on the case (03/06/2022).

Almond, J. E. 2022. Northern Cape Palaeontological Heritage Input: Hoogland 1 Wind Farm and Hoogland 2 Wind Farm between Loxton and Beaufort West, Western and Northern Cape Provinces.

The specialist noted that the appointed archaeologist inspected the proposed stream crossings who stated that the crossings are unlikely to have good exposure of the Beaufort Group bedrock or older consolidated alluvium, in which fossils are likely to occur.

The specialist continues to state that the recommendations of the original PIA state that a walkthrough of the final layout of the development is to be conduct once the layout is finalised, and that the stream crossings could be inspected at that time, to save on time and expenses.

Interim Comment

The SAHRA Archaeology, Palaeontology and Meteorites (APM) Unit is not satisfied with the motivation for no field-based PIA to be conducted of the stream crossings during the EIA phase of the EA application, as it does not comply with the 2012 PIA Minimum Standards. As per section 24(4)b(iii) of NEMA, it is incumbent on the EAP to assess all impacts to the environment prior to the decision-making stage and prior to the authorisation of the development to ensure that the risk and impacts to both the heritage resources and to the project are identified so that may be mitigated prior to the development commencing. Unlike the layout of the WEF, the position of the stream crossings will not change, and as such the stream crossings must be assessed to the satisfaction of SAHRA during the EIA phase so that the competent authority has all the necessary information to make a decision regarding the authorisation of the proposed development.

As such, SAHRA waits the requested field-based PIA of the stream crossings before further comments will be issued.

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Should you have any further queries, please contact the designated official using the case number quoted above in the case header.

Yours faithfully

Natasha Higgitt
Heritage Officer
South African Heritage Resources Agency

Phillip Hine
Manager: Archaeology, Palaeontology and Meteorites Unit
South African Heritage Resources Agency

ADMIN:
Direct URL to case: https://sahris.sahra.org.za/node/594209
(DEA, Ref: To be allocated)

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