PROPOSED JESSA M, JESSA S AND JESSA Z GRID CONNECTION INFRASTRUCTURE PROJECTS, BEAUFORT WEST MUNICIPALITY, WESTERN CAPE PROVINCE

Palaeontological Heritage Report

DFFE References:	To be Allocated
Report Prepared by:	**Dr John E. Almond (*Natura Viva* cc)**
Issue Date:	**February 2022**
Version No.:	**2**

EXECUTIVE SUMMARY

ENERTRAG South Africa (Pty) Ltd ("ESA") is proposing to construct three adjoining wind energy facilities (WEFs) *plus* three associated grid connection projects - together known as the JESSA Projects – on a site near Beaufort West in the Western Cape Province of South Africa. It should be noted that this Palaeontological Heritage Report has been compiled for the JESSA Grid Connection projects (namely JESSA Z, JESSA M and JESSA S Grid Connection projects) specifically, while a separate, standalone Palaeontological Heritage Report has been compiled for the three adjoining JESSA WEF projects (namely JESSA Z, JESSA M and JESSA S WEFs). The present combined desktop and field-based Palaeontological Heritage Report assesses anticipated impacts on local palaeontological heritage resources due to the JESSA Grid Connection projects (namely JESSA Z, JESSA M and JESSA S Grid Connection), including 132kV overhead powerlines, one switching station *per* WEF, access roads and a possible expansion of the existing Droërivier Main Transmission Substation (MTS), situated *c*. 8 km southwest of Beaufort West, where the power generated by the JESSA WEFs (assessed as part of separate standalone Palaeontological Heritage Report) will be fed into the National Grid.

The combined JESSA Grid Connection project area, situated in the Great Karoo region near the town of Beaufort West is underlain by potentially fossiliferous continental (fluvial / lacustrine) sediments of the Lower Beaufort Group (Karoo Supergroup) that are assigned to the uppermost Abrahamskraal Formation (Karelskraal Member) and lowermost Teekloof Formation (Poortjie Member). The contact zone between the Karelskraal Member and Poortjie Member is of particular geological and palaeontological interest because it records environmental and biotic changes on land associated with the catastrophic end Middle Permian Mass Extinct Event of *c*. 260 million years ago. The northern sector of the combined JESSA Grid Connection project area traverses the internationally recognised Type Area for the previously defined *Pristerognathus* Assemblage Zone, centred on dissected hilly terrain close to the border between Farm 432 (property affected by JESSA Z and JESSA S Grid Connection projects) and Farm 10/170 (property affected by JESSA Z, JESSA M and JESSA S Grid Connection projects).

A scatter of historical vertebrate fossil sites of Middle to Late Permian age have been reported within the combined JESSA Grid Connection project area in the scientific literature. A substantial number of additional fossil sites have been recorded over the course of several recent site visits to the combined JESSA WEF and Grid Connection project areas (2020-2021) as well as during a previous palaeontological survey of part of Farm 10/170 by Almond (2014). While most of the fossils recorded here so far are of limited scientific or conservation value (*e.g.* highly weathered, fragmentary post-cranial bones, common invertebrate trace fossils), several vertebrate specimens are of considerable research interest. These include, most notably, skull material of large-bodied dinocephalians, gorgonopsian and therocephalian carnivores, small and medium-sized dicynodonts and the well-preserved skull of a rare temnospondyl amphibian. Several of these key fossil specimens have subsequently been formally collected by the Evolutionary Studies Institute (ESI), Wits University, Johannesburg and no further mitigation is therefore required in these particular cases. A range of Late Caenozoic superficial deposits (alluvium, colluvium, eluvial gravels, soils, spring deposits *etc*) overlying large portions of the Lower Beaufort Group bedrocks are generally of low palaeosensitivity. The only fossils recorded from the Late Caenozoic superficial deposits within the JESSA Grid Connection project area are locally dense assemblages of calcretized rhizoliths (plant root casts) and/or termite burrows within older alluvial deposits along major drainage lines such as the Gamka River; these trace fossils are of widespread occurrence in the Great Karoo and of low scientific or conservation value.

No palaeontological heritage "No-Go" areas have been identified within the grid connection corridors for the respective grid connection projects, while all the remaining recorded sites can potentially be effectively mitigated by professional palaeontological recording and collection in the pre-construction phase, if they are threatened by the proposed JESSA Grid Connection developments (*i.e.,* located < 20 m from the final footprints).

A provisional VERY HIGH palaeosensitivity is assigned to the majority of the combined Jessa Grid Connection project area by the DFFE Screening Tool. **This rating is, however, *contested* here**. **Given the sparse distribution of scientifically valuable fossil sites within the combined JESSA Grid Connection project area (all corridors), the overall palaeosensitivity of the project area is revised to LOW**. However, the occurrence of additional, unrecorded sites of High sensitivity within the grid corridors for the respective grid connection projects cannot be excluded since palaeontological surveying of such a large area has necessarily been at reconnaissance level.

In terms of palaeontological heritage, the Construction Phase impact significance of each of the proposed JESSA Grid Connection projects (namely JESSA M, JESSA S and JESSA Z Grid Connection), including all the component infrastructure listed in the project descriptions (electrical pylons, access roads, switching stations, possible MTS expansion *etc*), is assessed as MEDIUM (negative) without mitigation and VERY LOW (negative) following mitigation. It is noted that construction of access roads may have a greater impact on fossil heritage than pylon footings and other infrastructure. No significant further impacts are anticipated in the Operational and De-commissioning Phases. This assessment applies equally to the preferred and alternative grid connection network (as well as to each separate grid connection application for the JESSA M, JESSA S and JESSA Z Grid Connection projects), so there is no preference for one or other alternative on palaeontological heritage grounds.

The impact significance of the "No-Go" Alternative would probably, on balance, have a neutral impact on palaeontological heritage. This is applicable to all three (3) proposed JESSA Grid Connection projects. Anticipated cumulative impacts of the proposed JESSA WEF (namely JESSA Z, JESSA M and JESSA S WEFs) and Grid Connection (namely JESSA Z, JESSA M and JESSA S Grid Connection) renewable energy projects in the context of several authorised WEF, solar and grid connection projects in the Beaufort West area are assessed as MEDIUM (negative) without mitigation, falling to LOW (negative) 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 JESSA Grid Connection projects (namely JESSA Z, JESSA M and JESSA S), including the possible MTS expansion, and there are no objections to their authorization**.

The final, authorised layouts of the respective JESSA Grid Connection projects (JESSA Z, JESSA M and JESSA S) must be cross-checked against the available fossil database and other relevant resources (*e.g.* satellite imagery, geological maps) by the palaeontological specialist who must make recommendations for pre-construction phase mitigation, if any proves necessary (*N.B.* Most of the recorded fossil sites do not warrant mitigation). This might entail, for example, focussed palaeontological walk-downs of selected, previously unsurveyed and potentially sensitive sectors of the respective project footprints, with judicious sampling or collection of potentially threatened fossil material of scientific and/or conservation value. A Work Plan approved by Heritage Western Cape (HWC) will be required by the specialist palaeontologist responsible for mitigation work.

Given the potential for the exposure or recognition of additional, scientifically valuable fossil occurrences within the JESSA Grid Connection project footprints during the Construction Phase, a Chance Fossil Finds Protocol (as outlined below and tabulated in Appendix 5) 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 respective grid connection developments must be made aware of the possibility of important fossil remains (vertebrate bones, teeth, burrows, petrified wood, plant-rich horizons *etc*.) being found or unearthed during the construction phase of the respective developments. 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 of each respective grid connection development is therefore recommended. Significant fossil finds must be safeguarded and reported at the earliest opportunity to HWC 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).

NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) (NEMA) AND ENVIRONMENTAL IMPACT ASSESSMENT (EIA) 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;	page vi - vii
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1, Appendix 4
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2.3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 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;	Section 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;	Section 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;	Figs. 61 & 62
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 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;	Sections 5.3, 5.4 & 7
k) any mitigation measures for inclusion in the EMPr;	Section 8
l) any conditions for inclusion in the environmental authorisation;	Section 8
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 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;	Section 9
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 10
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q) any other information requested by the competent authority.	N/A
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.	N/A

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 JESSA WIND ENERGY FACILITIES: JESSA M, JESSA S AND JESSA Z GRID CONNECTION INFRASTRUCTURE, BEAUFORT WEST MUNICIPALITY, WESTERN CAPE

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

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

SPECIALIST INFORMATION

Specialist Company Name:	NATURA VIVA CC			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100
Specialist name:	Dr John Edward Almond			
Specialist Qualifications:	PhD (palaeontology)			
Professional affiliation/registration:	Palaeontological Society of Southern Africa, Association of Professional Heritage Practitioners (W Cape)			
Physical address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN 8001, RSA			
Postal address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN 8001, RSA			
Postal code:	8010	Cell:	n/a	
Telephone:	021 462 3622	Fax:	n/a	
E-mail:	naturaviva@universe.co.za			

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.

John E. Almond

Signature of the Specialist

NATURA VIVA CC

Name of Company

February 2022

Date

CONTENTS

SPECIALIST INFORMATION vii

DECLARATION BY THE SPECIALIST vii

CONTENTS viii

1. INTRODUCTION 1

2. ASSESSMENT METHODOLOGY 1

2.1 Specialist Credentials 1

2.2 Terms of Reference (ToR) 1

2.3 Information sources 2

2.4 Study approach 2

2.5 Assumptions and Limitations 4

3. LEGAL REQUIREMENT AND GUIDELINES 5

4. GRID CONNECTION PROJECT DESCRIPTION 6

4.1 Main infrastructural components 6

4.2 Project Location 7

4.3 Project Alternatives and Routing of Corridors 10

5. BASELINE DESCRIPTION OF THE RECEIVING ENVIRONMENT 15

6. SENSITIVITY MAPPING 50

7. SPECIALIST FINDINGS ASSESSMENT OF IMPACTS 50

7.1 Brief comparison of grid connection options 50

7.2 MTS expansion area 51

7.3 Impact assessment 51

7.4 Alternatives 53

7.4.1 Grid Connection 53

7.4.2 Main Transmission Substation Expansion 54

7.4.3 "No-Go" Alternative 54

7.5 Cumulative Impacts 54

8. MITIGATION AND EMPr REQUIREMENTS 57

9. CONCLUSIONS AND SUMMARY 59

9.1 Summary of Findings 59

9.2 Conclusions and Impact Statement 61

10. ACKNOWLEDGMENTS 61

11. REFERENCES 62

JESSA GRID CONNECTION PIA - APPENDICES 67

APPENDIX 1: JOHN ALMOND SHORT CV 67

SUMMARY 75
1.INTRODUCTION 75
2. OUTCOME OF SITE SENSITIVITY VERIFICATION 78

LIST OF TABLES

Table 1: Summary of the project technical details for the Jessa S/M/Z Grid Connection Projects 7
Table 2: JESSA Grid Connection Farm Portions 8
Table 3: Assessment of potential palaeontological heritage impacts of the proposed JESSA Grid Connection Projects (JESSA M, JESSA S, JESSA Z) near Beaufort West (Construction Phase) - preferred as well as alternative options 52
Table 3: Assessment of potential cumulative palaeontological heritage impacts relating to the proposed JESSA grid connection projects 56
Table 5: Summary of proposed palaeontological heritage mitigation and monitoring actions for the JESSA Grid Connection projects 58

LIST OF FIGURES

Figure 1: Regional context map for the JESSA M, JESSA S and JESSA Z WEFs and associated grid connection to the Droërivier Substation near Beaufort West, Beaufort West Municipality, Western Cape Province. 8
Figure 2: Locality Map for Jessa M Grid Connection project 9
Figure 3: Locality Map for Jessa S Grid Connection project 9
Figure 4: Locality Map for Jessa Z Grid Connection project 10
Figure 5: Powerline route alternatives to link proposed Jessa M WEF project to existing Eskom Droërivier MTS..... 11
Figure 6: Powerline route alternatives to link proposed Jessa S WEF project to existing Eskom Droërivier MTS..... 12
Figure 7: Powerline route alternatives to link proposed Jessa Z WEF project to existing Eskom Droërivier MTS..... 13
Figure 8: WEF connecting grid corridors to link proposed Jessa M, Jessa S and Jessa Z WEF projects 14
Figure 9: Google Earth© satellite image of the JESSA Grid Connection project area (blue corridors) situated in semi-arid hilly terrain of the Great Karoo to the southwest of Beaufort West in the context project areas for the JESSA Z (orange), JESSA S (red) and JESSA M (green) WEF projects 16
Figure 10: Geology Map. Extracted from the Council for GeoSciences Map 3222 for Beaufort West indicating that the development area is underlain by Pa: Abrahamskraal Formation and Pt: Teekloof Formation, both of the Adelaide Subgroup of the Beaufort Group of sediments (CTS Heritage 2022). 17
Figure 11: Stratigraphic subdivision of the Karoo Supergroup with the rock units and fossil biozones most relevant to the present study outlined in green (Modified from Smith et al. 2020) .. 18
Figure 12: Flat, gravelly terrain in the NE sector of Farm 432 looking north-eastwards towards the existing metal pylon powerline with low, rounded hills of Poortjie Member mudrocks in the middle distance on the right. 18

Figure 13: A scenic waterfall due to advanced stream incision through a major channel sandstone package exposed along the edge of the Poortjie Member escarpment on Farm 432. 19

Figure 14: Good exposure of thin-bedded, grey-green and purple-brown distal floodplain mudrocks (probably Poortjie Member) in the bed of the Lombaardskraal se Loop, Farm 432 19

Figure 15: Low, south-facing scarp of probable Poortjie Member distal floodplain mudrocks on the northern banks of the Lombaardskraal se Loop, Farm 432 20

Figure 16: Detail of succession shown in the previous illustration showing package of thin-bedded siltstone-claystone couplets – possibly a lacustrine facies (Hammer = 30 cm) 20

Figure 17: In situ, pale yellowish-green, well-jointed tuffite horizon (mixed volcanic ash and terrigenous sediment) within the Poortjie Member on Farm 432 (hammer = 30 cm) 21

Figure 18: Low relief vlaktes covered by sandy soils and sparse eluvial gravels on the Poortjie Member sandstone plateau, Farm 432 looking north. 21

Figure 19: Low relief gravelly terrain along the existing eastern (wooden pylon) transmission line on Farm 432. 22

Figure 20: Thick mudflake breccia unit at the base of a Poortjie Member channel sandstone showing complex internal geometry of cross-cutting breccia bodies indicating an episode of energetic denudation of the ancient Karoo floodplain (hammer = 30 cm), eastern margins of Farm 432 22

Figure 21: Deeply dissected hilly terrain dominated by resistant-weathering, yellowish sandstone packages of the upper Poortjie Member, north-eastern sector of Farm 432. 23

Figure 22: Well-exposed, thick mudrock package within the middle part of the Poortjie Member exposed in a low, sandstone-capped escarpment in the north-eastern sector of Farm 432 23

Figure 23: Area of excellent, gently hilly exposure of a thick mudrock package within the middle Poortjie Member close to the boundary between Farms 10/170 and 432 24

Figure 24: Well-developed, extensive horizon of rusty-brown, ferruginous calcrete representing an arid palaeosol within the Poortjie Member, Farm 432 24

Figure 25: Typical orange-hued surface gravels derived from a local tuffite horizon, Poortjie Member, Farm 10/170. 25

Figure 26: Local areas of good mudrock exposure associated with shallow stream gullies, existing transmission line corridor on Farm 10/170. 25

Figure 27: Stream gulley exposure of purple-brown and grey-green mudrocks with pedogenic calcrete horizons just south of the Gamka River – possibly within the uppermost Abrahamskraal Formation, Farm 10/170. 26

Figure 28: Grey-green mudrocks with ferruginous pedocretes and thin wacke interbeds exposed on the southern banks of the Gamka River, Farm 10/170 26

Figure 29: Thick deposits of semi-consolidated, calcretised older sandy and gravelly alluvium overlain by unconsolidated sandy alluvium and modern soils on the southern banks of the Gamka River (Hammer = 30 cm) 27

Figure 30: Gullied exposures of thick, well-bedded, semi-consolidated silty to sandy alluvium along the southern banks of the Gamka River, Farm 10/170 27

Figure 31: View northwards across the Gamka River Valley from the elevated southern bank showing areas of greyish, gravel-patinated older alluvium in the middle ground and finer, pale brown, younger alluvium in the distance with the Nuweveld Escarpment in the background 28

Figure 32: Wide exposure of hackly-weathering, grey-green mudrocks in the bed of the Gamka River. These rocks are provisionally mapped within the Abrahamskraal Formation 28

Figure 33: Thick, unconsolidated sandy deposits associated with the modern Gamka River, here showing a white mineral efflorescence (probably a spectrum of sulphates and chlorides), just outside and east of Farm 10/170. 29

Figure 34: Stream bank bedrock exposure just west of the N12 (and east of Farm 10/170) showing a package of interbedded, medium-bedded grey-green wackes and mudrocks, provisionally mapped within the Poortjie Member. 29

Figure 35: View to the NNW towards the Droërivier MTS expansion area on Farm 10/170 showing the several meter-thick package of alluvial sands and gravels that overlies the bedrocks in this region, exposed here in a stream bank. 30

Figure 36: Flat terrain with dispersed eluvial gravels (mainly wacke, with some dolerite, quartzite, hornfels) seen within large parts of the Droërivier MTS expansion area, here looking towards south-westwards the two existing powerlines. 30

Figure 37: Banks of moderately- to well-rounded, cobbly to bouldery dolerite, wacke and quartzite gravels on the southern margins of the Droërivier MTS expansion area representing relict alluvial gravels bars of the Gamka – Droërivier confluence. 31

Figure 38: Droërivier MTS expansion area showing flat terrain underlain by alluvial soils and sparse to concentrated eluvial surface gravels. Note the lack of bedrock exposure here. 31

Figure 39: Distribution of recorded vertebrate fossil sites within the he Main Karoo Basin (modified from Nicolas 2007) 34

Figure 40: Vertebrate fossil localities within the Lower Beaufort Group in the region southwest of Beaufort West where the boundary between the Abrahamskraal and Teekloof Formations is highly folded (dotted line) 34

Figure 41: Chart showing the ranges of known terrestrial tetrapod genera from the Middle to Late Permian of the Main Karoo Basin (From Day et al. 2015b) 35

Figure 42: Skulls of two key fossil therapsid tetrapods from the upper part of the Tapinocephalus Assemblage Zone – the small-bodied dicynodont Diictodon (top) and the large-bodied dinocephalian Styracocephalus 36

Figure 43: Skull of the robust, moderately large dicynodont Endothiodon which occurs within the middle to upper part of the Poortjie Member near Beaufort West (From Day & Smith 2020). 36

Figure 44: Artist's reconstructions of the ill-favoured late Middle Permian dinocephalians Styracocephalus (left) and Criocephalosaurus (right) 37

Figure 45: The original type area for the now-defunct Pristerognathus Assemblage Zone (AZ) extended across the N part of Farm Lombards Kraal 330 (From Smith & Keyser 1995b).... 37

Figure 46: Lower jaw and partial snout of a rare gorgonopsian carnivore with enlarged upper canine, upper Poortjie Member, Farm Weltevreden 10/170 (Loc. 011) (scale in cm and mm) (from Almond 2014) 38

Figure 47: Lower jaw of the robust, medium-sized dicynodont Endothiodon, upper Poortjie Member, Farm Weltevreden 10/170 (Loc. 011) (from Almond 2014) 38

Figure 48: Possibly complete skull of a large temnospondyl amphibian seen in oblique posyterodorsal view showing the characteristic complex surface ornamentation of dermal bones (scale in cm), middle Poortjie Member, Farm 232 (Loc. 218) 39

Figure 49: Reconstruction of the dorso-ventrally flattened skull of a rhinesuchid temnospondyl – the group of crocodile-like amphibian predators to which the skull illustrated above belongs (from Carroll 2009). 39

Figure 50: Block of well-indurated bone breccia containing a high concentration of bone shards – possibly reworked from sun-cracked skeletal material on the floodplain, Poortjie Member, Farm 432 (Loc. 219) (scale in cm and mm). 40

Figure 51: Two sun-cracked fragments of robust bone (possibly dinocephalian or pareiasaur) among surface float, having weathered out from a ferruginous pedocrete horizon in the Abrahamskraal Formation on Farm Weltevreden 10/170 (Loc. 760) (scale in cm). 40

Figure 52: 20 cm-long fragment of robust, highly-weathered bone – pareiasaur or dinocephalian - in surface float overlying the upper Abrahamskraal Formation (or possible lower Poortjie Member) on Farm Weltevreden 10/170 (Loc. 372). 41

Figure 53: Block of weathered robust bone (c. 11.5 cm across) among ferruginous pedcrete concretions of uppermost Abrahamskraal Formation or lower Poortjie Member on Farm Weltevreden 10/170 (Loc. 368). 41

Figure 54: Skull of a small-bodied dicynodont with a broad intertemporal region (possibly Pristerodon) seen in dorsal view, embedded within a pedogenic calcrete horizon, Poortjie Member, Farm Weltevreden 10/170 (Loc. 021) (scale in cm and mm) (From Almond 2014) 42

Figure 55: Skull of a small-bodied dicynodont (probably Diictodon) preserved within a pedocrete concretion, Poortjie Member, Farm Weltevreden 10/170 (Loc. 017) (scale in cm and mm). 42

Figure 56: Small dicynodont skull (c. 8 cm long) seen in dorsal view, probably suncracked and enclosed within a pedogenic calcrete concretion, Poortjie Member, Farm Weltevreden 10/170 (Loc. 370) 43

Figure 57: Cluster of pedocrete concretions containing skulls and postcranial remains of small-bodied dicynodonts, middle Poortjie Member, Farm Weltevreden 10/170 (Loc. 387) (scale in cm and mm) 43

Figure 58: Cluster of pedocrete concretions containing skulls and postcranial remains of small-bodied dicynodonts, middle Poortjie Member, Farm Weltevreden 10/ 170 (Loc. 385) (scale in cm and mm) 44

Figure 59: Partial skull of a small dicynodont showing well-developed canine tusk, 4.5 cm-wide pedogenic concretion in the Poortjie Member, Farm Weltevreden 10/ 170 (Loc. 380). 44

Figure 60: Pedogenic calcrete concretions containing skull and post-cranial remains of a small-bodied dicynodont, Poortjie Member, Farm Weltevreden 170/10 (Loc. 743) (scale in cm) 45

Figure 61: Stream bank exposure of hackly-weathering mudrocks of the Poortjie Member, Farm Weltevreden 170/10 (Loc. 743) containing sandstone casts of small, gently inclined tetrapod burrows that are probably attributable to dicynodonts (arrowed) (hammer = 30 cm). 45

Figure 62: Inclined cast of a small tetrapod burrow within Poortjie Member bedrocks on the bed of the Lombaardskraal se Loop, Farm 432 (Loc. 766) (hammer = 30 cm) 46

Figure 63: Exposure of calcretised older alluvium on the southern banks of the Gamka River containing dense assemblages of calcretised rhizoliths (plant root casts) and / or termite burrows, Farm Weltevreden 170/10 (hammer = 30 cm). 46

Figure 64: Google Earth© satellite images of the JESSA M Grid Connection feeding into the existing Droërivier MTS, showing numbered fossil sites recorded during recent PIA palaeontological surveys (2014, 2020, 2021) 47

Figure 65: Google Earth© satellite images of the JESSA S Grid Connection feeding into the existing Droërivier MTS, showing numbered fossil sites recorded during recent PIA palaeontological surveys (2014, 2020, 2021). 48

Figure 66: Google Earth© satellite images of the JESSA Z Grid Connection feeding into the existing Droërivier MTS, showing numbered fossil sites recorded during recent PIA palaeontological surveys (2014, 2020, 2021) 49

Figure 67: Map showing authorised renewable energy projects within a 35 km radius of the JESSA WEF and Grid Connection projects near Beaufort West 56

LIST OF APPENDICES

Appendix 1: John Almond short CV

Appendix 2: JESSA WEFs and grid connections - fossil site data

Appendix 3: Site Sensitivity Verification Report

Appendix 4: Terms of Reference (ToR) for the palaeontological heritage study

Appendix 5: Chance Fossil Finds Protocol

LIST OF ABBREVIATIONS

amsl	above mean sea level
BA	Basic Assessment
DFFE	Department of Forestry, Fisheries and the Environment
EA	Environmental Authorisation
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
ESI	Evolutionary Studies Institute, Wits University, Johannesburg
EMPr	Environmental Management Programme
ESO	Environmental Site Officer
HIA	Heritage Impact Assessment
HWC	Heritage Western Cape
Ma	Millions of years ago
MTS	Main Transmission Substation
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NHRA	National Heritage Resources Act (Act No. 25 of 1999)
PIA	Palaeontological Heritage Impact Assessment
SAHRIS	South African Heritage Resources Information System
ToR	Terms of Reference
WEF(s)	Wind Energy Facility / Facilities

1. INTRODUCTION

Dr John E. Almond (*Natura Viva* cc) has been appointed by SLR South Africa Consulting (Pty) Ltd (hereafter referred to as "SLR Consulting"), on behalf of ENERTRAG South Africa (Pty) Ltd (hereafter referred to as "ESA"), to undertake a palaeontological heritage study for the proposed construction of three wind energy facilities (WEFs) (namely JESSA M, JESSA S and JESSA Z WEF) and three associated grid connection projects (namely JESSA Z, JESSA M and JESSA S Grid Connection) (together known as the JESSA Projects) near the town of Beaufort West in the Western Cape Province of South Africa (Figure 1).

In terms of the EIA Regulations various aspects of the proposed grid connection and WEF developments 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 respective JESSA WEF and grid connection projects under the Gazetted specialist protocols (GN R 320 and GN R 1150 of 2020).

It should be noted that this Palaeontological Heritage Report has been compiled for the JESSA Grid Connection projects (namely JESSA Z, JESSA M and JESSA S Grid Connections) specifically, while a separate standalone Palaeontological Heritage Report has been compiled for the three adjoining JESSA WEF projects (namely JESSA Z, JESSA M and JESSA S WEFs). The present combined desktop and field-based Palaeontological Heritage Report therefore assesses anticipated impacts on local palaeontological heritage resources due to the JESSA Grid Connection projects, including 132kV overhead powerlines, one switching station *per* WEF, access roads and a possible expansion of the existing Droërivier Main Transmission Substation (MTS), situated *c*. 8 km southwest of Beaufort West, where the power generated by the JESSA WEFs will be fed into the National Grid.

This report has been written in accordance with the requirements for specialist reports as per Appendix 6 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended).

Three (3) applications for EA for the respective proposed grid connection infrastructure projects will be submitted to the DFFE, in the form of separate respective Basic Assessment (BA) processes, in terms of the EIA Regulations, 2014 (as amended). Even though these developments are the subject of three (3) separate respective applications and BA processes, they have been considered in the same specialist report.

2. ASSESSMENT METHODOLOGY

2.1 Specialist Credentials

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

2.2 Terms of Reference (ToR)

The present combined desktop and field-based Palaeontological Heritage Impact Assessment (PIA) report assesses potential impacts to palaeontological heritage resources that may result from the proposed JESSA M, JESSA S and JESSA Z Grid Connection projects. It will contribute to the over-arching Heritage Impact Assessments (HIAs), co-ordinated by CTS Heritage and SLR Consulting, as part of the BA processes for these respective grid connection developments as well as to the relevant EMPrs.

Please see Appendix 4 for the SLR Terms of Reference (ToR) applicable to this report.

2.3 Information sources

This desktop and field-based palaeontological heritage study of the proposed JESSA M, JESSA S and JESSA Z Grid Connection renewable energy 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 (3222AD Klipbank, 3222BC Beaufort West, 3222CB Letjiesbos & 3222DA Moerbeifontein) as well as the 1:250 000 scale topographic map 3222 Beaufort West;
   (b) Google Earth© satellite imagery;
   (c) published geological and palaeontological literature, including 1:250 000 geological maps (3222 Beaufort West) and the relevant sheet explanation (Johnson & Keyser 1979);
   (d) several previous palaeontological heritage assessments (PIAs) in the Great Karoo region near Beaufort West by the author (See References under Almond), especially the Droërivier Solar Facility by Almond (2014) and the Screening Study for the Lombaardskraal Renewable Energy Facility by Almond (2020a).

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

4. An approximately two week-long palaeontological field assessment of the combined JESSA WEF (JESSA Z, JESSA M and JESSA S WEF) and JESSA Grid Connection (JESSA Z, JESSA M and JESSA S Grid Connection) project areas by the author and an experienced field assistant (Ms Madelon Tusenius, Natura Viva cc), during the periods 10-15 July 2020, 22-27 August 2021, 4 September 2021 and 25-26 October 2021. This study also incorporates field data for sectors of the JESSA Grid Connection corridors that were previously surveyed for the Droërivier Solar Facility by John Almond (2014). Additional short palaeontological visits to the JESSA WEF and Grid Connection project area were made in the company of Professor Bruce Rubidge and Dr Marc van den Brandt (ESI, Wits University) on 16 March and 26 October 2021.

It should be noted that the season in which the site visits took place has no critical bearing on the palaeontological study.

2.4 Study approach

In preparing a palaeontological desktop study, the potentially fossiliferous rock units (groups, formations, members etc.) represented within the study area for the JESSA Grid Connection projects 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 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 impact palaeontologists to collect representative, well-localised (e.g. GPS and stratigraphic data) samples of fossil material during field assessment studies. In order to do so, a fossil collection permit from Heritage Western Cape (HWC) is required and all fossil material collected must be properly curated within an approved repository (usually a museum or university collection).

Note that while fossil localities recorded during field work within the study area itself are obviously highly relevant, most fossil heritage here is embedded within rocks beneath the land surface or obscured by surface deposits (soil, alluvium, etc.) and by vegetation cover. In many cases, where levels of fresh (*i.e.,* unweathered) bedrock exposure are low, the hidden fossil resources have to be inferred from palaeontological observations made from better exposures of the same formations elsewhere in the region but outside the immediate study area. Therefore, a palaeontologist might reasonably spend 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 JESSA WEF and Grid Connection renewable energy projects and (2) the often 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 visits 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.

2.5 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 South Africa 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 project areas for the JESSA M, JESSA S and JESSA Z WEFs and associated Grid Connection projects, exposure of potentially fossiliferous sedimentary bedrocks varies from locally excellent to very poor. In areas of low relief (*e.g.* northern sectors of the WEF project area and much of the Grid Connection project area) bedrock exposure it is highly constrained by extensive superficial deposits, as well as, to a lesser extent, by shrubby vegetation. The total combined project area for the WEF and Grid Connection projects is very

extensive (approx. 13 000 ha), 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*. 14 days in total).

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 approximately 2 two week long field study to assess the palaeontological heritage sensitivity of the main rock units represented within the combined JESSA M, JESSA S and JESSA Z Grid Connection project 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 REQUIREMENT AND GUIDELINES

The present combined desktop and field-based palaeontological heritage report for the JESSA Grid Connection projects (JESSA Z, JESSA M and JESSA S Grid Connection) falls under Sections 35 and 38 (Heritage Resources Management) of the National Heritage Resources Act (Act No. 25 of 1999) (NHRA), and it will also inform the EMPr for each respective grid connection project.

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the NHRA 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 NHRA, 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. GRID CONNECTION PROJECT DESCRIPTION

ESA is proposing to construct three grid connection projects (which include 132kV overhead powerlines, 3 switching stations, access roads and a possible expansion of the existing Droërivier MTS) to service the three adjoining JESSA WEFs (assessed part of a separate standalone Palaeontological Heritage Report), together known as the JESSA Projects, on a site near the town of Beaufort West in the Western Cape Province. ESA proposes to connect all three JESSA WEF projects to the nearby Eskom Droërivier MTS through a powerline, transmitting up to 132kV (either single or double circuit). The powerline will follow the route of an existing Eskom 400kV powerline to the MTS. The power generated by the JESSA WEFs will be fed into the National Grid.

4.1 Main infrastructural components

The principal infrastructural components of the proposed JESSA Grid Connection projects (namely JESSA Z, JESSA M and JESSA S) include the following (See also Table 1):

- An onsite high voltage collector substation (33kV/132kV) per Grid Connection project, to allow for the potential of multiple feeder bays of up to 132kV, as well as transformers, a control building, telecommunication infrastructure and access roads;
- 132kV overhead powerlines (either single or double circuit), connecting each proposed JESSA WEF project to each other *via* the substations;
- 132kV overhead transmission lines from each proposed JESSA WEF substation to the existing Eskom Droërivier MTS;
- Temporary laydown areas;
- Access roads and tracks; and
- Upgrades to the existing Eskom Droërivier MTS (within the current footprint); or
- if required, an expansion / additional 132kV/400 kV MTS (approx. 20ha footprint).

ESA proposes to connect all three (3) WEF projects to the nearby existing Eskom Dröerivier MTS through powerlines, transmitting up to 132kV (either single or double circuit). The proposed grid connection projects therefore aim to feed the electricity generated by the proposed Jessa WEF projects into the national grid.

To allow efficient transmission, the electricity generated by the wind turbines undergoes a voltage 'step-up' process that occurs at each wind turbine, where power is stepped up to a maximum of 33kV (either in the turbine or in a small transformer container next to the turbine) and again at each WEF substation where power is stepped up to 132kV. The power is then transferred through a switching station (next to each WEF substation) along a 132kV line where it will connect into the Droërivier MTS and will form part of the national grid.

Table 1: Summary of the project technical details for the Jessa S/M/Z Grid Connection Projects

Component	Details
Access roads	1. Site access: via existing access points from the N12, or via new access roads, as determined by the traffic engineer. Right of Way (ROW) access will need to cross the Jessa M WEF (part of separate respective BA process and assessed in standalone PIA Report) and will be granted via a contract for the projects. 2. Access road(s) to the project sites and internal roads between project components will be developed within a corridor of 20m wide, to allow for fluctuating road widths as necessitated by cable trenches, stormwater channels and turning circle / bypass areas. 3. Existing roads will be upgraded wherever possible, although new roads will be constructed where necessary.
On-site Substations	1. Each project will have an onsite substation of 33/132kV, including a transformer. 2. Palisade fencing of 3m height will be placed around the substation complex encompassing the onsite buildings, as per Eskom's specifications.
Construction camps	1. Each project will include a construction camp with alternative locations for each project. 2. Typical area: 100m x 50m = 5000m^2. 3. The camps will use portable toilets and sceptic tanks during the construction phase.
Temporary construction laydown / staging areas	1. Each project will include a laydown area. 2. Approximately 22000m^2. Laydown area could increase to 30000m^2 for concrete towers, should they be required. 3. Possible concrete batching plant at each WEF
Boreholes and storage tanks (if applicable)	1. The use of onsite boreholes, as far as technically possible, if water quality standards are met. To be decided upon with landowner. 2. Storage tanks 3. Other water source alternatives will be considered, including water supply from the local Municipality or bulk water supplier in the region 4. Temporary water containment tanks (i.e., Jojo tanks) may be used during the construction phase for water supply, whilst permanent tanks may be placed above the O&M buildings

4.2 Project Location

The JESSA Grid Connection project area is located in the Great Karoo region *sensu stricto*, approximately 8 to 15km southwest of the town Beaufort West in the Beaufort West Local Municipality, Western Cape Province (Figure 1). The site is located to the west of the N12 Beaufort West to Oudtshoorn tar road, on the farms listed in Table 2 below.

Table 2: JESSA Grid Connection Farm Portions

Project name	Farm portion & number	Farm name	21-digit code
Jessa Z Grid Connection	Portion 0 of Farm 432	Beaufort West Road	C00900000000043200000
	Portion 10 of Farm 170	Weltevreden	C00900000000017000010
	Portion 1 of Farm 319	Boeteka	C00900000000031900001
	Portion 5 of Farm 319	Boeteka	C00900000000031900005
	Portion 6 of Farm 319	Boeteka	C00900000000031900006
	Portion 7 of Farm 319	Boeteka	C00900000000031900007
Jessa M Grid Connection	Portion 10 of Farm 170	Weltevreden	C00900000000017000010
	Portion 0 of Farm 330	Lombards Kraal	C00900000000033000000
	Portion 1 of Farm 319	Boeteka	C00900000000031900001
	Portion 5 of Farm 319	Boeteka	C00900000000031900005
	Portion 6 of Farm 319	Boeteka	C00900000000031900006
Jessa S Grid Connection	Portion 0 of Farm 432	Beaufort West Road	C00900000000043200000
	Portion 10 of Farm 170	Weltevreden	C00900000000017000010
	Portion 0 of Farm 319	Boeteka	C00900000000031900000
	Portion 1 of Farm 319	Boeteka	C00900000000031900001
	Portion 5 of Farm 319	Boeteka	C00900000000031900005

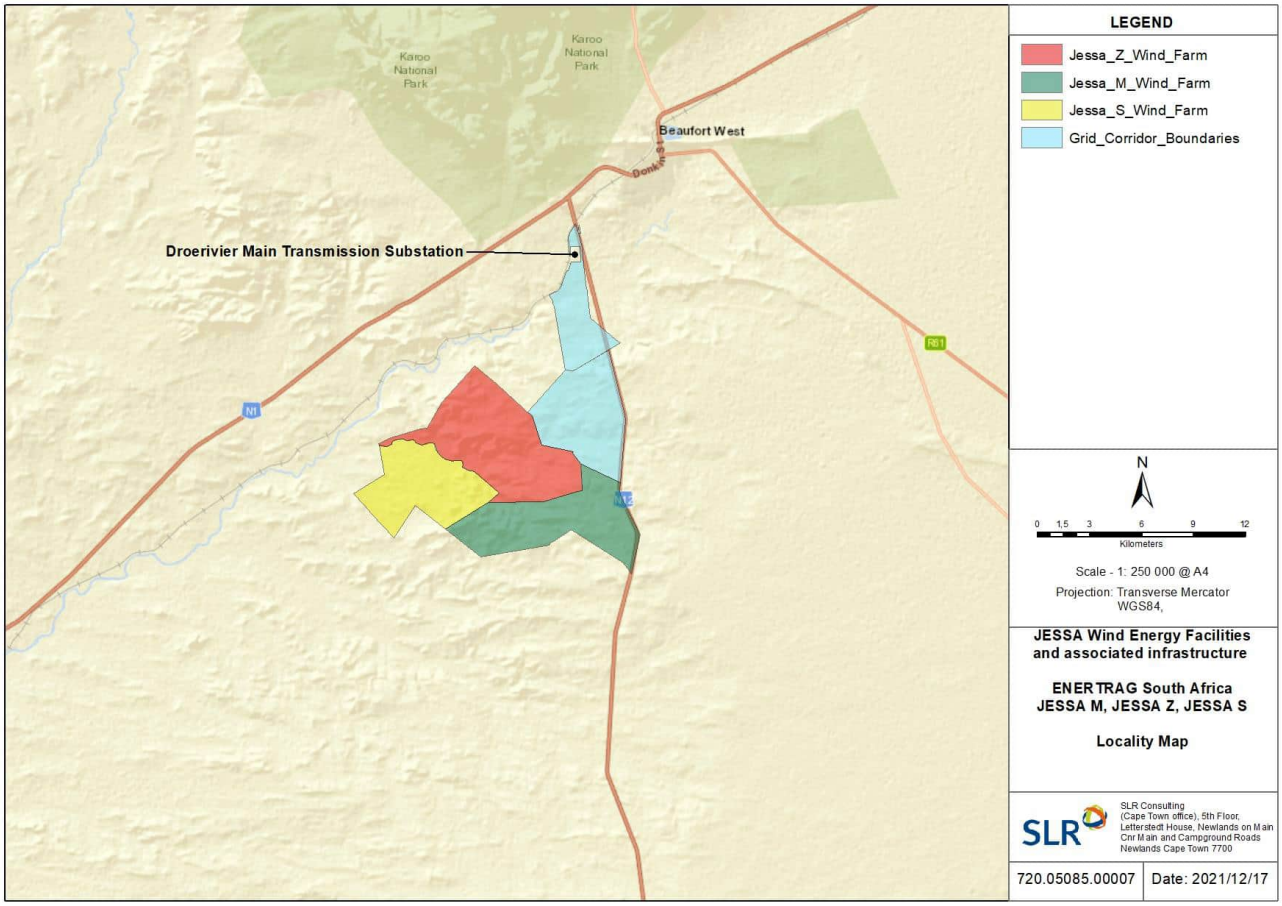

Figure 1: Regional context map for the JESSA M, JESSA S and JESSA Z WEFs and associated grid connection to the Droërivier Substation near Beaufort West, Beaufort West Municipality, Western Cape Province.

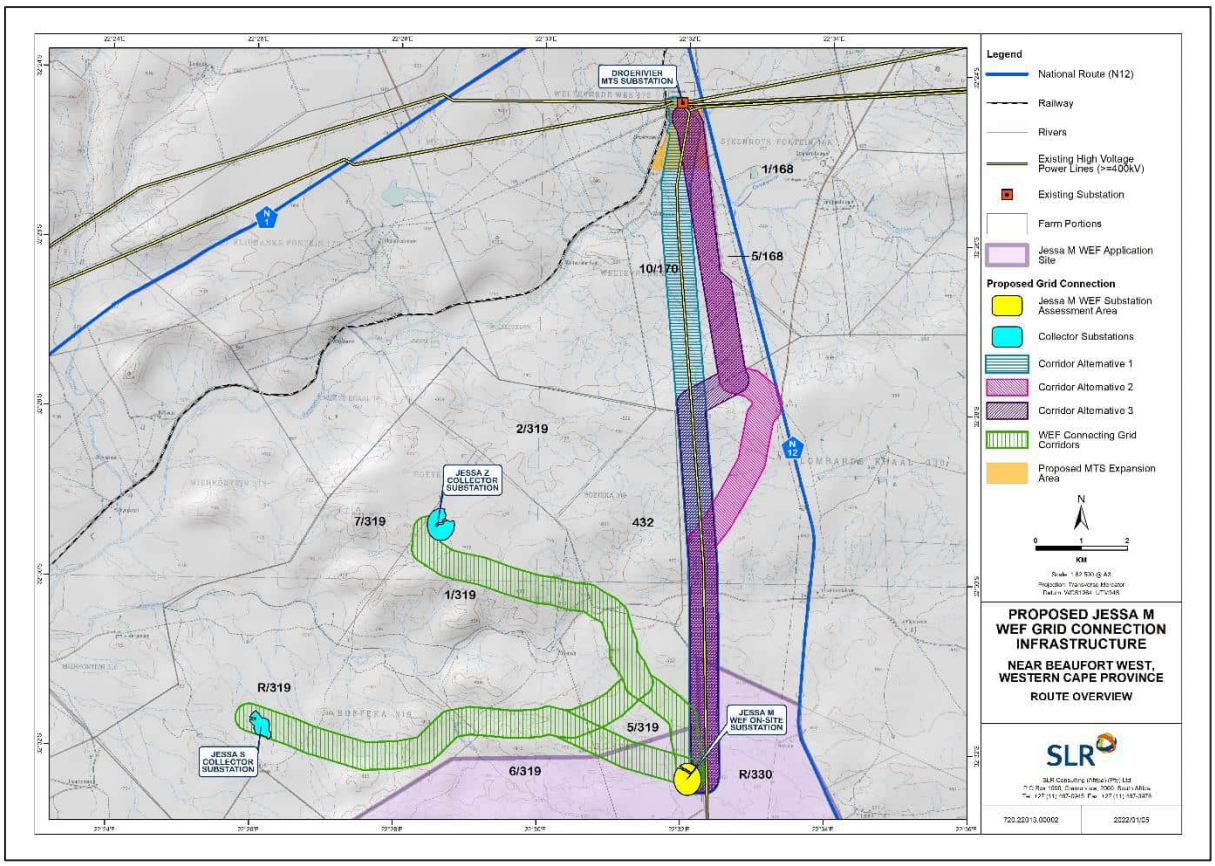

Figure 2: Locality Map for Jessa M Grid Connection project

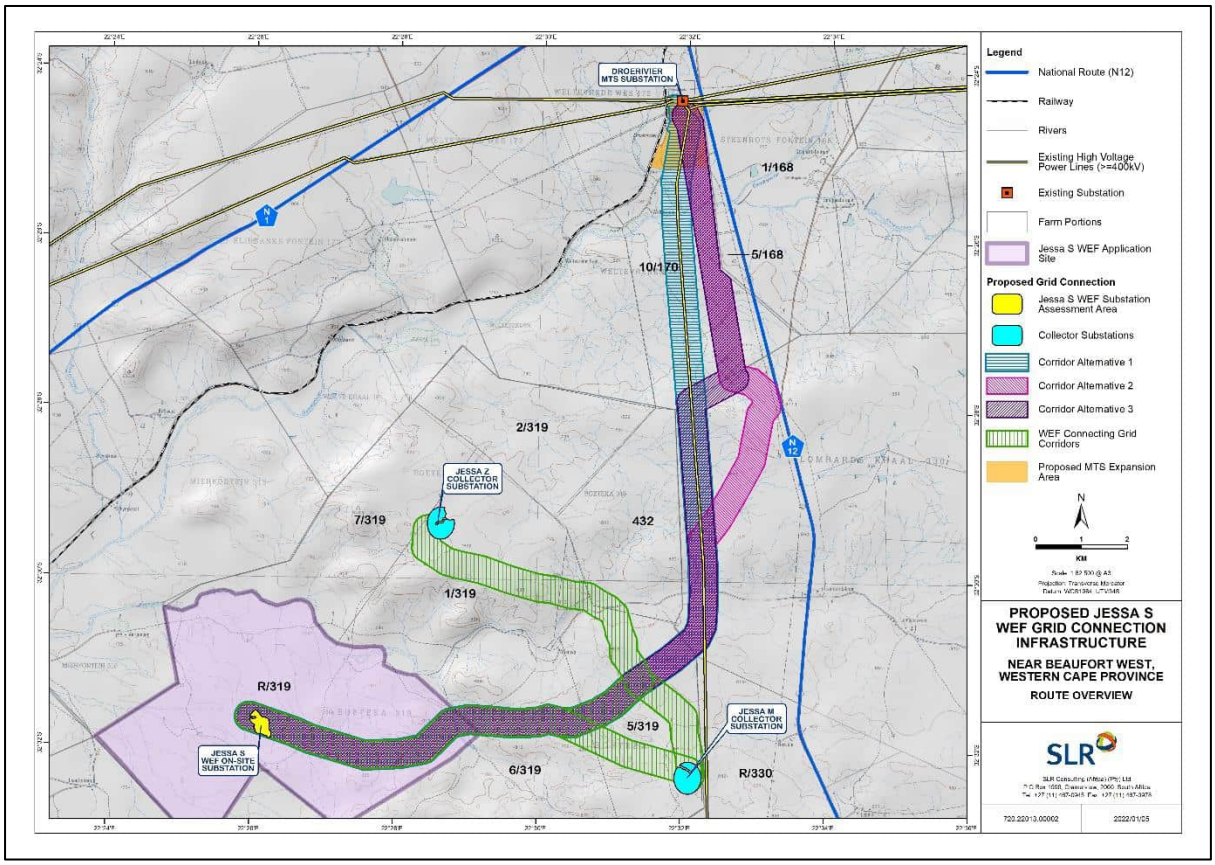

Figure 3: Locality Map for Jessa S Grid Connection project

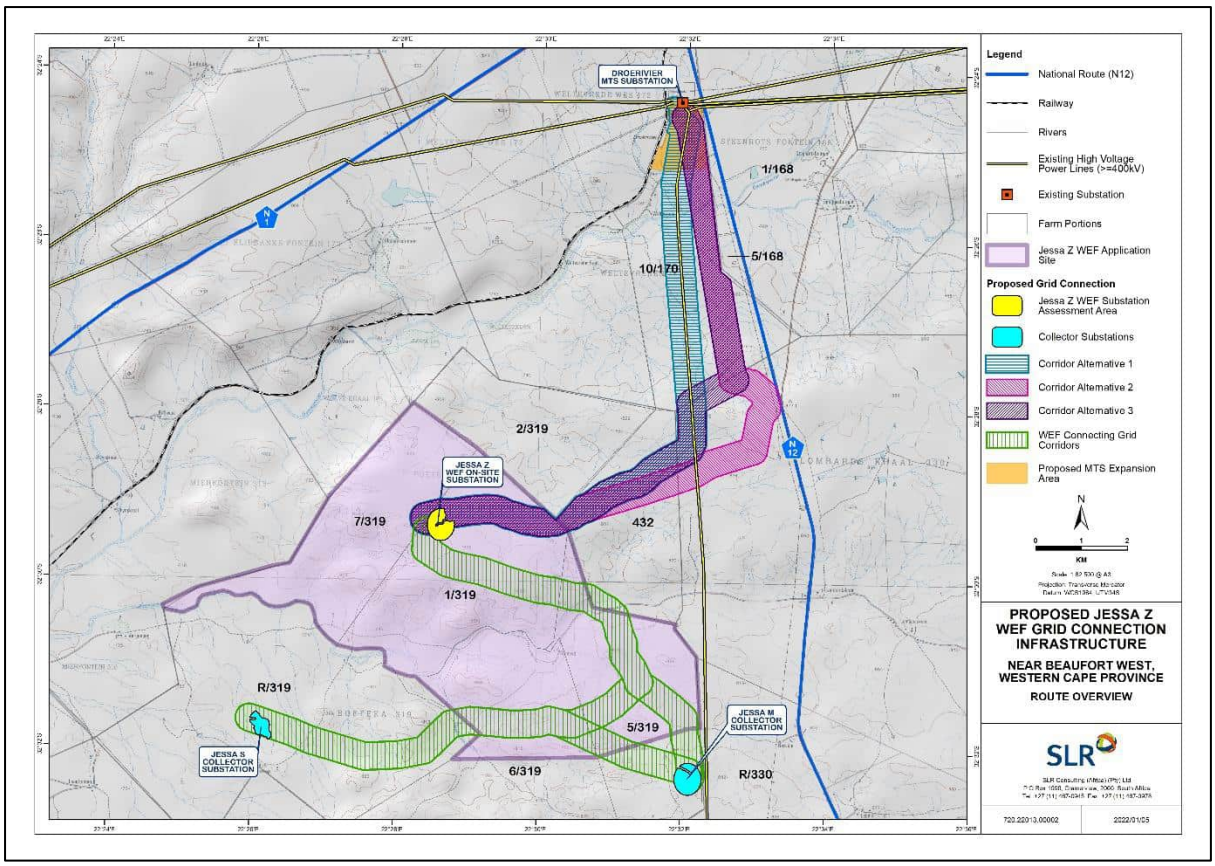

Figure 4: Locality Map for Jessa Z Grid Connection project

4.3 Project Alternatives and Routing of Corridors

A site area of up to approximately 300 000m^2 (*i.e*. 550m x 550m or approximately 30ha) will also be assessed for the switching station portion of the substation[1] and connection of the associated powerlines which form part of each Grid Connection project.

In addition, as part of the site area, three 132kV powerline route alternatives will be assessed for each Grid Connection project, to link each proposed Jessa WEF project to the existing Eskom Droërivier MTS (see Figures 5-7 below). Powerline corridors with widths of 600m (*i.e.* 300m on either side of centre line) are being considered and assessed for the powerline route alternatives, to allow flexibility when routing the proposed powerlines within the authorised corridors.

It should be noted that only one of the above-mentioned powerline corridor route alternatives will be required per Grid Connection project and has thus been comparatively assessed from a palaeontological perspective.

[1] Laydown, O&M buildings, ablutions and BESS will also be located within the 30ha footprint and are included in the respective Jessa WEF projects.

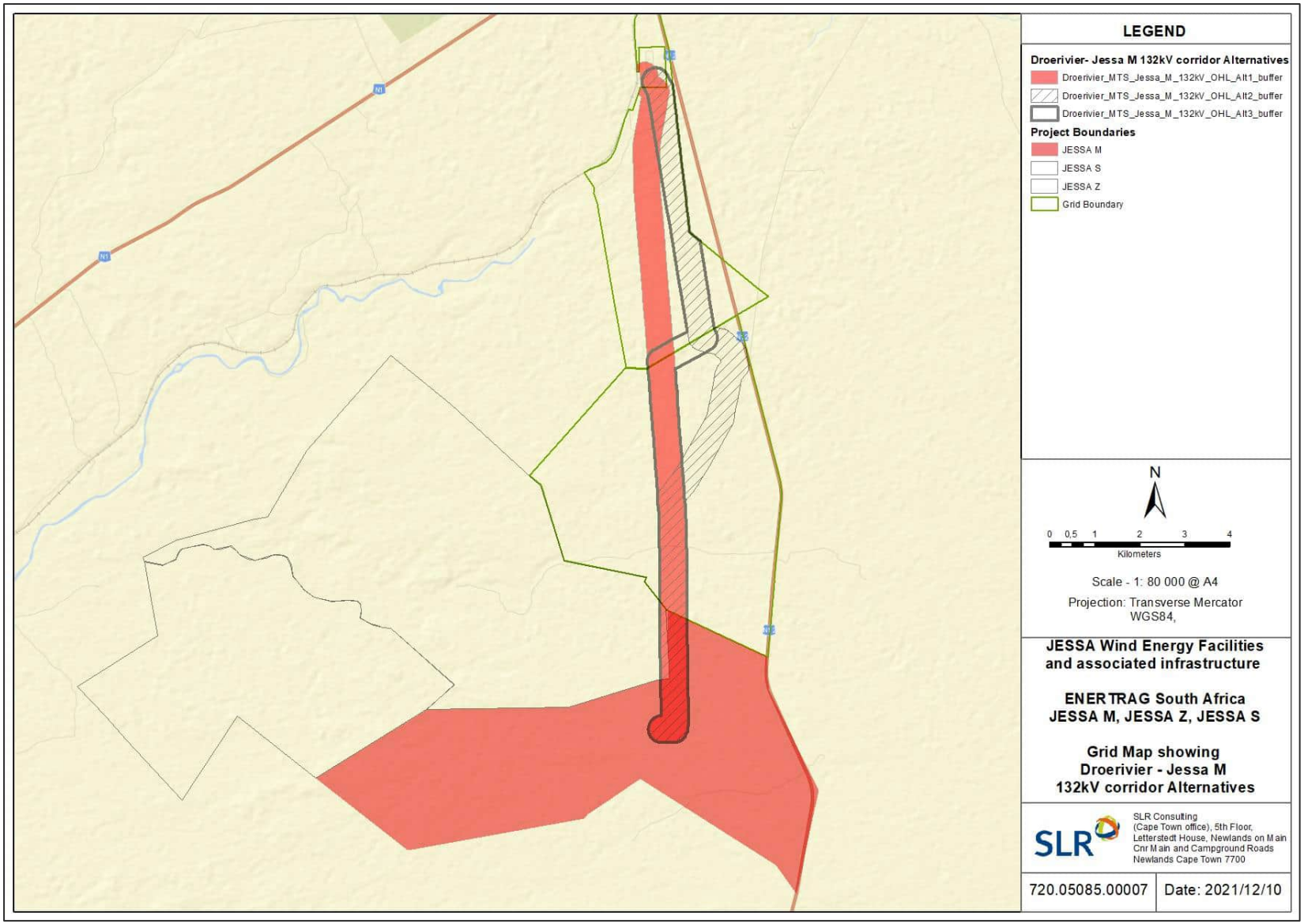

Figure 5: Powerline route alternatives to link proposed Jessa M WEF project to existing Eskom Droërivier MTS

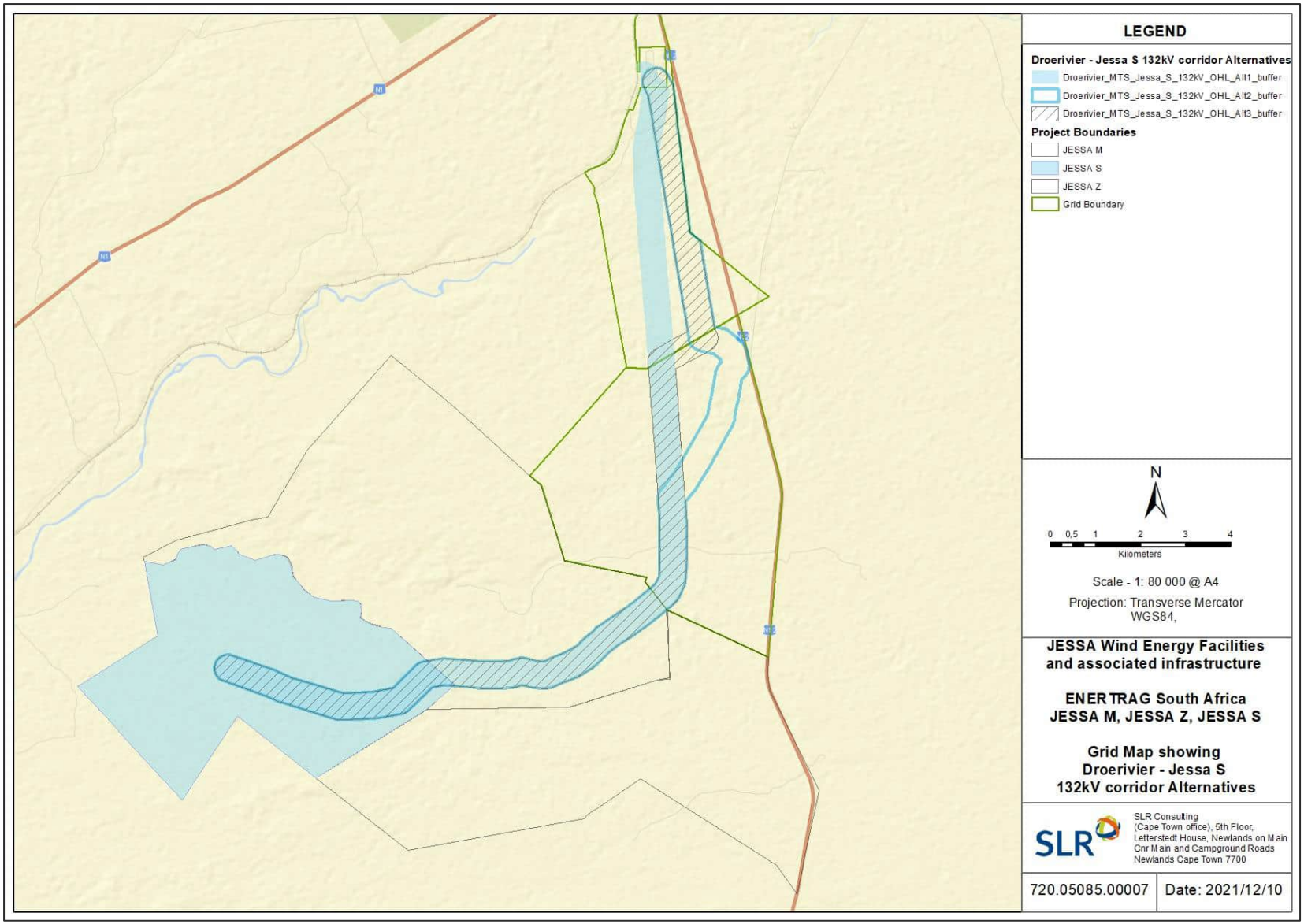

Figure 6: Powerline route alternatives to link proposed Jessa S WEF project to existing Eskom Droërivier MTS

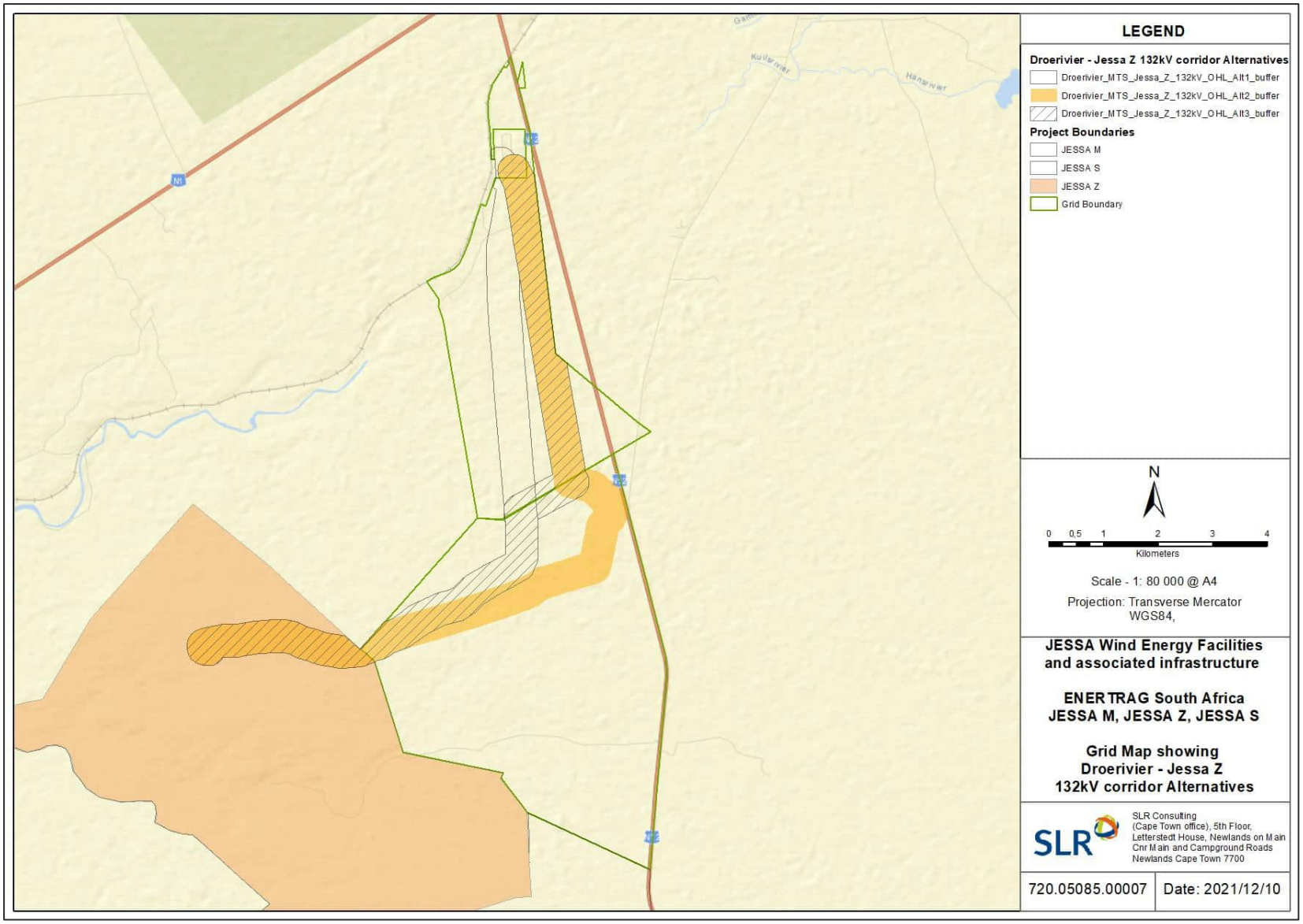

Figure 7: Powerline route alternatives to link proposed Jessa Z WEF project to existing Eskom Droërivier MTS

In addition to the powerline route alternatives to link the proposed Jessa WEF projects to the existing Eskom Dröerivier MTS mentioned above, three 132kV WEF connecting grid corridors to link the respective Jessa WEF projects (*i.e.* Jessa M – Jessa S; Jessa Z – Jessa M and Jessa Z to Jessa S) are also being assessed and proposed for authorisation (see Figure 8 below). Powerline corridors with widths of 600m (*i.e*. 300m on either side of centre line) have been considered and assessed for these WEF connecting grid corridors as well, to allow flexibility when routing the proposed powerline within the authorised corridors.

It should be noted that the Grid Connection projects are intrinsically linked to the WEF projects and three WEF connecting grid corridors are required to ensure that the respective Jessa WEF projects connect to various connector substations, which will feed electricity generated by the WEF projects into the national grid via 132kV powerlines connecting to the Dröerivier MTS (Figure 8). As such, all three WEF connecting grid corridors being assessed will need to be authorised by the DFFE, to allow the respective Jessa WEF projects to connect to the national grid, should one of the proposed grid connection infrastructure projects not received EA.

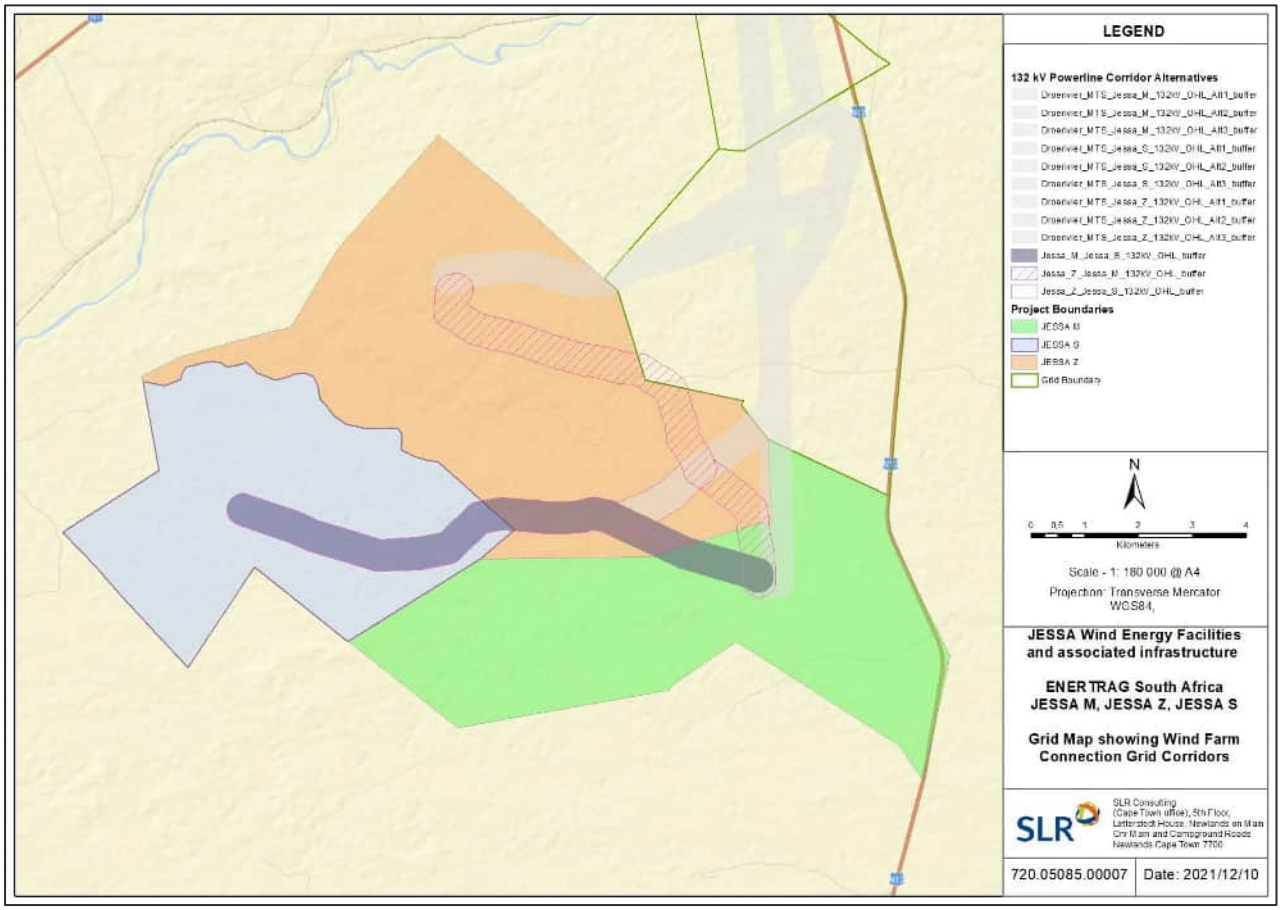

Figure 8: WEF connecting grid corridors to link proposed Jessa M, Jessa S and Jessa Z WEF projects

In addition, as an alternative to connecting directly to the existing Eskom Droërivier MTS, ESA will explore the possible expansion of the MTS. A 20-30 ha area has been assessed for this purpose, over portion 10 of Farm Weltevreden which is located near the existing Eskom MTS (See Figures 2-4).

5. BASELINE DESCRIPTION OF THE RECEIVING ENVIRONMENT

5.1. Geological context of the JESSA project area

The combined JESSA WEF and Grid Connection project area lies due south of the N1 national road and the railway from Beaufort West to Cape Town, and on the western side of the N12 tar road to Oudtshoorn (Fig. 9). The project area is situated in semi-arid terrain of the Great Karoo region *sensu stricto*, encompassing large areas of low relief *vlaktes* as well as dissected hilly terrain located some 5 to 25 km south of the Nuweveld Escarpment - part of the Great Escarpment of southern Africa. The region is typified by thin, gravelly, skeletal soils and sparse, desert-adapted karroid *bossieveld* vegetation with acacia woodland restricted to major drainage lines. Local drainage feeds into the ancient Gamka River system which largely runs to the west of the project area; the shallow to fairly deeply-incised Gamka River Valley as well as its tributary the Droërivier run south-westwards across the Grid Connection project area in the north. West-flowing tributaries of the Gamka draining the WEF project area include the Boetakarivier – Lombaards se Loop and the Weenfonteinrivier with their dendritic network of numerous, non-perennial feeder streams. Fairly flat, gravelly plains with low *koppies* and scarps characterize large sectors of the northern WEF and Grid Connection project area. In contrast, the central and southern sectors of the WEF project area feature a wealth of dissected, hilly terrain with ridges and *koppies* reaching up to 880 m amsl (*e.g.,* Goliatskop 815 m amsl., Langbakenkop 880 m amsl., elevations of 845-870 m amsl. in the north). Scenic scarps capped by sandstone bedrocks are seen in the northwest, facing down onto the Gamka River Valley and in the central zone overlooking the confluence of the Boeteka and Weenfontein River Valleys. On the eastern side of the project area the deeply-incised margin of a low relief, sandstone-dominated plateau (pale orange-brown on satellite images) overlooks highly dissected, mudrock dominated, lower-lying terrain towards the west (purplish and grey on satellite images). Due to the arid climate, dense drainage network as well as moderately high relief, levels of bedrock exposure are often high, and locally excellent, with the exception of the gravelly *vlaktes* in the north and northeast.

The geology of the Beaufort West area is depicted in 1: 250 000 geology sheet 3222 Beaufort West (Council for Geoscience, Pretoria; Johnson & Keyser 1979) (Fig. 10). Lower-lying terrain in the western half or so of the JESSA project area as well as along the floor of the Gamka River Valley is underlain by late Middle Permian continental sediments of the **Abrahamskraal Formation** (Lower Beaufort Group / Adelaide Subroup, Karoo Supergroup) (Pa, pale green in Fig. 10) (Johnson & Keyser 1979, Johnson *et al.* 2006). The bedrocks here can be largely or entirely assigned to the mudrock-dominated **Karelskraal Member** at the top of the very thick Abrahamskraal succession (see stratigraphic column Fig. 11). Slightly higher and locally more rugged terrain in the eastern half of the project area is underlain by the conformably overlying, sandstone-rich **Poortjie Member** at the base of the **Teekloof Formation** (Adelaide Subgroup) (Pt, dark green in Fig. 10). The mapping of the boundary between the Abrahamskraal and Teekloof Formations is to an extent equivocal and only shown schematically on the 1: 250 000 geology map. The sedimentology of the Abrahamskraal – Teekloof transition has been addressed recently by Paiva (2015). Early Jurassic intrusions of the **Karoo Dolerite Suite** are not mapped within the project area but do occur some 7 km to the north-east (elongate rusty-red line in Fig. 10). Levels of tectonic deformation within the project area are generally low, with only gentle folding of the Beaufort Group bedrocks along broadly west-east axes, as indicated on the geological map (Fig. 10). However, small-scale faulting is picked out on the ground by concentrations of milky quartz gravels and surfaces displaying vein quartz mineral lineation while locally the mudrock facies may show a pervasive spaced cleavage and the sandstones may be highly jointed.

The Palaeozoic bedrocks in the study area are often well to very well exposed, especially in areas of dissected terrain (*e.g.* Figs. 15, 22). In areas of low relief (*e.g.,* sandstone plateau in the east, gravelly *vlaktes* in the north), on many

hillslopes as well as along water courses the bedrocks are mantled by various Late Caenozoic superficial sediments (*e.g.* Figs.12, 18, 19, 25, 30 & 36). For the most part these comprise downwasted surface gravels, colluvial deposits, silty to gravelly alluvium (pale yellow areas in Fig. 10) and various soils with local development of spring deposits. Most of the superficial deposits are unconsolidated and probably of Pleistocene to Holocene age (*i.e.,* last 2.5 million years) but some alluvium and spring deposits are extensively calcretised and in some cases might be somewhat older.

Photographs illustrating representative geological scenery or unusually good exposures of sedimentary rock units within the Grid Connection project area are provided in Figures 12 to 38 below (Exposures within the main JESSA WEF project area are illustrated in the accompanying PIA report).

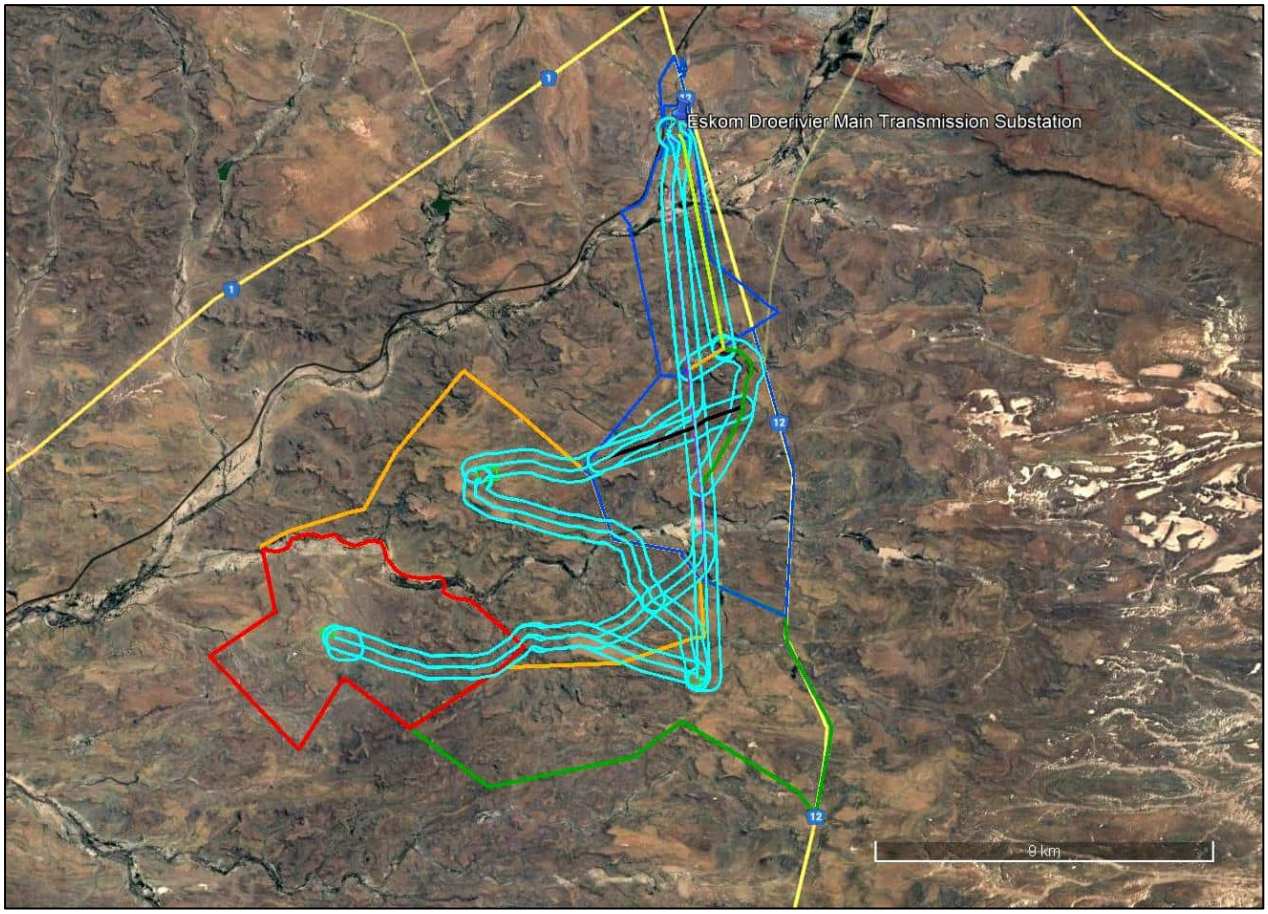

Figure 9: Google Earth© satellite image of the JESSA Grid Connection project area (blue corridors) situated in semi-arid hilly terrain of the Great Karoo to the southwest of Beaufort West in the context project areas for the JESSA Z (orange), JESSA S (red) and JESSA M (green) WEF projects. The 132 kV overhead lines will feed into the existing Droerivier MTS.

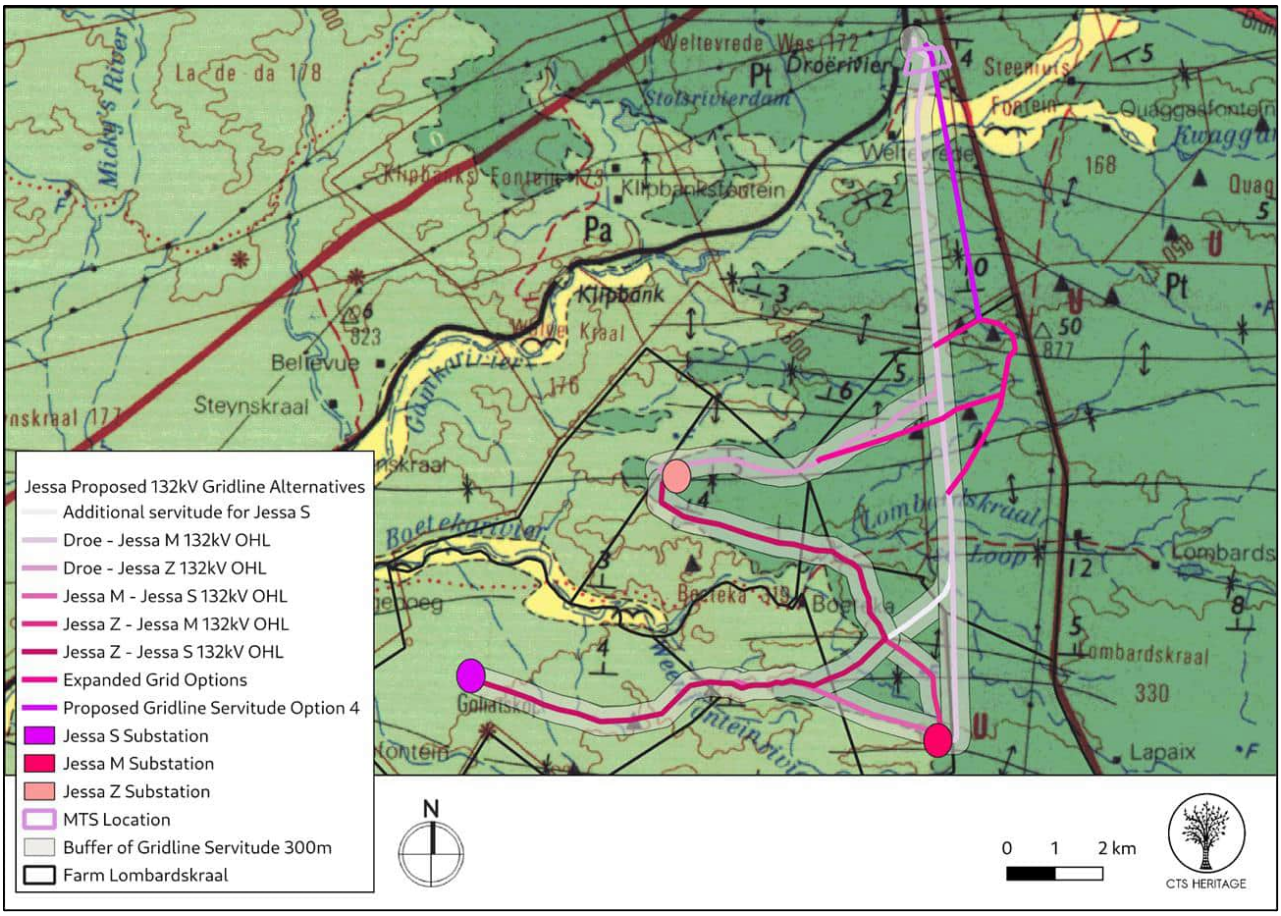

Figure 10: Geology Map. Extracted from the Council for GeoSciences Map 3222 for Beaufort West indicating that the development area is underlain by Pa: Abrahamskraal Formation and Pt: Teekloof Formation, both of the Adelaide Subgroup of the Beaufort Group of sediments (CTS Heritage 2022).

Pa (pale green) = Abrahamskraal Formation (Adelaide Subgroup, Lower Beaufort Group). Pt (dark green) = Teekloof Formation. Jd (red) = Karoo Dolerite Suite. Yellow = Quaternary superficial sediments, including alluvium (pale yellow with flying bird symbol), sheet wash, colluvium, soils, locally cemented by pedocretes such as calcrete (Qc). Diamond symbols indicating fossil localities within the Tapinocephalus Assemblage Zone are not shown within the project area. Triangles indicate historical fossil sites within the Pristerognathus Assemblage Zone (N.B. This fossil biozone data is now outdated).

U = uranium anomalies within the Poortjie Member sandstones.

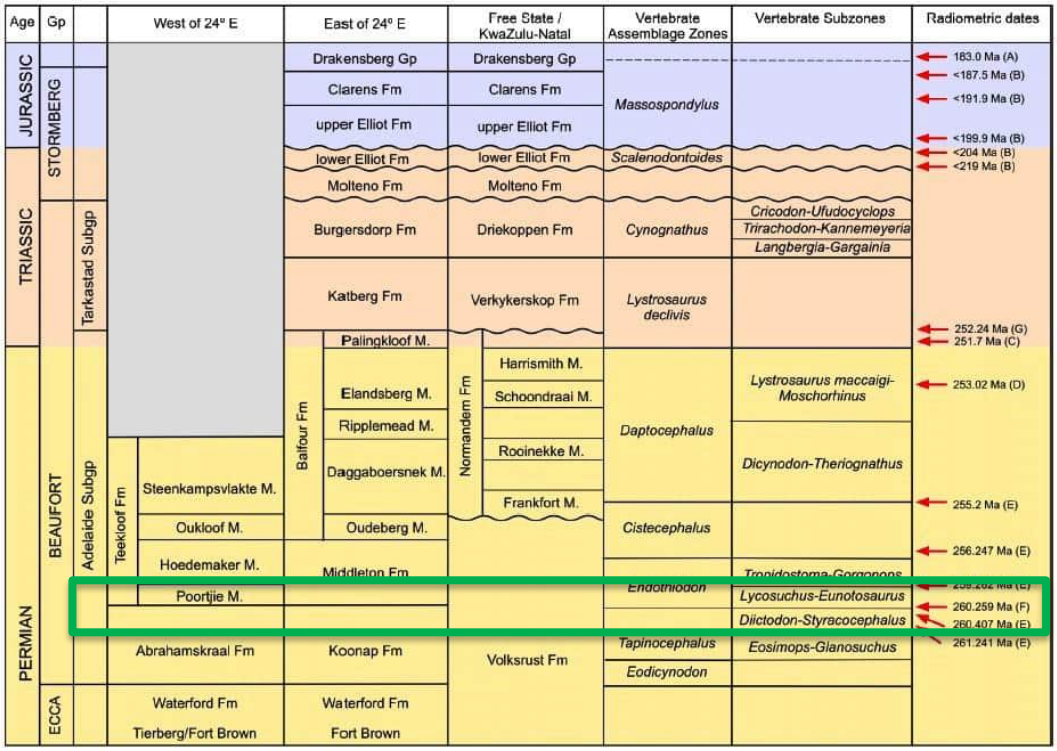

Figure 11: Stratigraphic subdivision of the Karoo Supergroup with the rock units and fossil biozones most relevant to the present study outlined in green (Modified from Smith et al. 2020). The sedimentary bedrocks of the Lower Beaufort Group here are approximately 260 million years old.

Figure 12: Flat, gravelly terrain in the NE sector of Farm 432 looking north-eastwards towards the existing metal pylon powerline with low, rounded hills of Poortjie Member mudrocks in the middle distance on the right.

Figure 13: A scenic waterfall due to advanced stream incision through a major channel sandstone package exposed along the edge of the Poortjie Member escarpment on Farm 432.

Figure 14: Good exposure of thin-bedded, grey-green and purple-brown distal floodplain mudrocks (probably Poortjie Member) in the bed of the Lombaardskraal se Loop, Farm 432.

Figure 15: Low, south-facing scarp of probable Poortjie Member distal floodplain mudrocks on the northern banks of the Lombaardskraal se Loop, Farm 432.

Figure 16: Detail of succession shown in the previous illustration showing package of thin-bedded siltstone-claystone couplets – possibly a lacustrine facies (Hammer = 30 cm). The beds here contain dispersed gypsum rose pseudomorphs as well as sandstone mudcrack infills and thin mudflake-rich debrites.

Figure 17: **In situ*, pale yellowish-green, well-jointed tuffite horizon (mixed volcanic ash and terrigenous sediment) within the Poortjie Member on Farm 432 (hammer = 30 cm). Such horizons (up to c. 20 cm thick) can be radiometrically dated and often have wave-rippled bed tops and internal wavy ripple cross-lamination indicating deposition within shallow floodplain ponds.***

Figure 18: Low relief vlaktes covered by sandy soils and sparse eluvial gravels on the Poortjie Member sandstone plateau, Farm 432 looking north.

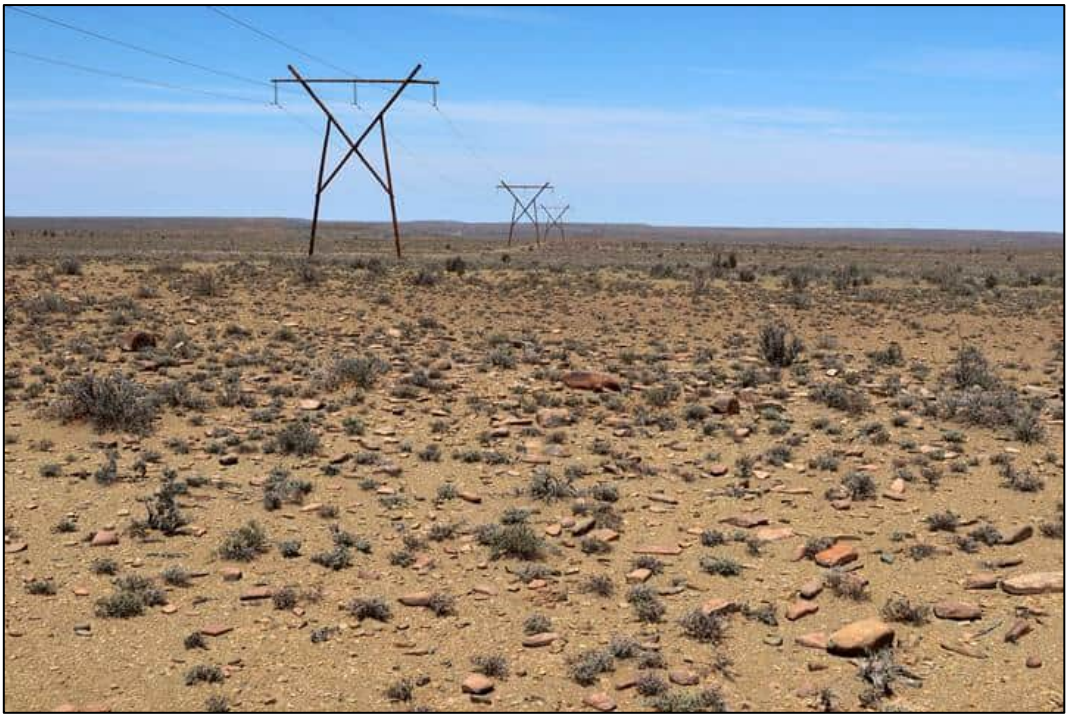

Figure 19: Low relief gravelly terrain along the existing eastern (wooden pylon) transmission line on Farm 432.

Figure 20: Thick mudflake breccia unit at the base of a Poortjie Member channel sandstone showing complex internal geometry of cross-cutting breccia bodies indicating an episode of energetic denudation of the ancient Karoo floodplain (hammer = 30 cm), eastern margins of Farm 432. Channel breccias may be cross-bedded and occasionally contain foundered blocks of bank sediment as well as fragments of reworked fossil bone and tooth material.

Figure 21: Deeply dissected hilly terrain dominated by resistant-weathering, yellowish sandstone packages of the upper Poortjie Member, north-eastern sector of Farm 432.

Figure 22: Well-exposed, thick mudrock package within the middle part of the Poortjie Member exposed in a low, sandstone-capped escarpment in the north-eastern sector of Farm 432. These hills forms part of the Type Area for the* Pristerognathus *Assemblage Zone.

Figure 23: Area of excellent, gently hilly exposure of a thick mudrock package within the middle Poortjie Member close to the boundary between Farms 10/170 and 432. This area has yielded several skulls of small dicynodonts as well as a rare temnospondyl amphibian.

Figure 24: Well-developed, extensive horizon of rusty-brown, ferruginous calcrete representing an arid palaeosol within the Poortjie Member, Farm 432. These ancient soils horizons are a primary focus for fossil vertebrate recording.

***Figure 25**: Typical orange-hued surface gravels derived from a local tuffite horizon, Poortjie Member, Farm 10/170.*

Figure 26: Local areas of good mudrock exposure associated with shallow stream gullies, existing transmission line corridor on Farm 10/170.

Figure 27: Stream gulley exposure of purple-brown and grey-green mudrocks with pedogenic calcrete horizons just south of the Gamka River – possibly within the uppermost Abrahamskraal Formation, Farm 10/170.

Figure 28: Grey-green mudrocks with ferruginous pedocretes and thin wacke interbeds exposed on the southern banks of the Gamka River, Farm 10/170. These beds are mapped within the Abrahamskraal Formation.

Figure 29: Thick deposits of semi-consolidated, calcretised older sandy and gravelly alluvium overlain by unconsolidated sandy alluvium and modern soils on the southern banks of the Gamka River (Hammer = 30 cm). See also Figure 63 for calcretised alluvium in this area.

Figure 30: Gullied exposures of thick, well-bedded, semi-consolidated silty to sandy alluvium along the southern banks of the Gamka River, Farm 10/170. Such beds might contain Late Pleistocene to Holocene mammalian and mollusc remains, though none were recorded here.

Figure 31: View northwards across the Gamka River Valley from the elevated southern bank showing areas of greyish, gravel-patinated older alluvium in the middle ground and finer, pale brown, younger alluvium in the distance with the Nuweveld Escarpment in the background.

Figure 32: Wide exposure of hackly-weathering, grey-green mudrocks in the bed of the Gamka River. These rocks are provisionally mapped within the Abrahamskraal Formation.

Figure 33: Thick, unconsolidated sandy deposits associated with the modern Gamka River, here showing a white mineral efflorescence (probably a spectrum of sulphates and chlorides), just outside and east of Farm 10/170.

Figure 34: Stream bank bedrock exposure just west of the N12 (and east of Farm 10/170) showing a package of interbedded, medium-bedded grey-green wackes and mudrocks, provisionally mapped within the Poortjie Member. This succession has yielded several small dicynodonts and tetrapod burrows (Figs. 60 & 61).

Figure 35: View to the NNW towards the Droërivier MTS expansion area on Farm 10/170 showing the several meter-thick package of alluvial sands and gravels that overlies the bedrocks in this region, exposed here in a stream bank.

Figure 36: Flat terrain with dispersed eluvial gravels (mainly wacke, with some dolerite, quartzite, hornfels) seen within large parts of the Droërivier MTS expansion area, here looking towards south-westwards the two existing powerlines.

Figure 37: Banks of moderately- to well-rounded, cobbly to bouldery dolerite, wacke and quartzite gravels on the southern margins of the Droërivier MTS expansion area representing relict alluvial gravels bars of the Gamka – Droërivier confluence.

Figure 38: Droërivier MTS expansion area showing flat terrain underlain by alluvial soils and sparse to concentrated eluvial surface gravels. Note the lack of bedrock exposure here.

5.2. Palaeontological heritage context

Continental (terrestrial / lacustrine / fluvial) fossil biotas within the uppermost part of the Abrahamskraal Formation (Karelskraal Member) as well as within the lowermost portion of the Poortjie Member of the Teekloof Formation are now assigned to the ***Diictodon – Styracocephalus* Subzone** of the revised ***Tapinocephalus* Assemblage Zone** (AZ) that is of Middle Permian age (Late Capitanian, *c*. 262-260 Ma) (Day & Rubidge 2020) (See stratigraphic column (Fig. 11). These biotas are of special palaeobiological interest in that they reflect the major Late Capitanian or Guadalupian (late Middle Permian) Mass Extinction Event on land (See biostratigraphic chart in Fig. 41). The highly impoverished, post-extinction vertebrate fauna represented in the uppermost part of the *Diictodon – Styracocephalus* Subzone (upper Karelskraal Member - lowermost Poortjie Member) includes – or is inferred to include – only a few representatives of several tetrapod subgroups including temnospondyl amphibians, parareptiles (pareiasaurs, *Eunotosaurus*), dinocephalians (*e.g., Criocephalosaurus,* perhaps also *Anteosaurus, Titanosuchus*), dicynodonts (*e.g. Diictodon*), therocephalians (*e.g., Pristerognathus*) and gorgonopsians (Retallack *et al* 2006, Smith *et al.* 2012, Day *et al.* 2015a, 2015b, Day & Rubidge 2020, Day & Rubidge 2021, Marchetti *et al.* 2020) (Figs. 42 & 44).

Fossil assemblages within the middle and upper part of Poortjie Member are now assigned to the newly redefined ***Endothiodon* Assemblage Zone**, and in particular to the ***Lycosuchus – Eunotosaurus* Subzone** (Day & Smith 2020 and refs. therein). These continental biotas are about 260-258 million years old (latest Capitanian – earliest Wuchiapingian) and record the recovery phase following the Late Capitanian Mass Extinction Event. Vertebrate faunas include palaeoniscoid fish, rare temnospondyl amphibians (*e.g., Rhinesuchus*), the small, wide-ribbed tortoise-like parareptile *Eunotosaurus*, a variety of dicynodont herbivores (*e.g.,* small-bodied *Pristerodon, Diictodon* as well as the much more robust *Endothiodon*) *plus* a wide range of small- to large-bodied, carnivorous gorgonopsian and therocephalian therapsids (*e.g., Gorgonops, Lycosuchus, Ictidosuchoides*) (Fig. 43). Other fossil groups represented here include a range of invertebrate and vertebrate trace fossils (*e.g.,* tetrapod burrow casts), freshwater bivalves and vascular plants of the *Glossopteris* Flora (*e.g., Glossopteris, Schizoneura*).

These continental biotas were previously included within the old ***Pristerognathus* AZ**, the type locality for which was designated in the northern sector of Farm 330 Lombaardskraal (now Farm 432) near Beaufort West (Fig. 45) (Smith & Keyser 1995b, Smith *et al.* 2012). A substantial number of vertebrate fossils have been recorded here previously (see, for example, black triangle symbols on the published 1: 250 000 geological map, Fig. 10, fossil database maps provided by Keyser & Smith 1977-1978, Lucas 2007 abstracted here in Figs. 40 & 39 respectively) and this historically fossiliferous area remains one of special palaeontological heritage interest today.

5.3. New palaeontological heritage data

Fossil sites recorded during the recent (2020-2021) JESSA WEF and Grid Connection palaeontological site visits, as well as in the course of a previous field-based PIA project on the farm Weltevreden 10/170 (Almond 2014), are tabulated in Appendix 2 together with GPS data and a Provisional Field Rating. Material from several of these sites is illustrated in the accompanying PIA report for the JESSA WEF projects (Almond, 2021). Selected fossils from sectors of the Grid Connection project area situated outside the JESSA WEF project area are illustrated below in Figures 46 to 63, together with explanatory figure legends. The fossil sites are mapped on satellite images in Figures 64 to 66, with respect to the grid corridor options currently under consideration.

Most Lower Beaufort Group fossils listed in Appendix 2 are recorded from overbank mudrock rather than sandstone facies, while reworked bones or teeth (highly fragmentary) were only very occasionally recorded from the locally well-developed basal channel breccias here. The stratigraphic provenance of several specimens – whether uppermost

Abrahamskraal Formation or lower Poortjie Member – is occasionally ambiguous and may require revision in the light of more detailed mapping. Most of the fossils listed for the northern Grid Connection project area (Farms 10/170 and 432) are provisionally assigned to the Poortjie Member, following the 1: 250 000 geological map, with only a few examples of weathered robust bones and ambiguous tetrapod burrows attributed to the underlying Abrahamskraal Member. The great majority of the recorded fossil sites within or close to the grid connection corridors concern fragmentary or otherwise poorly-preserved vertebrate fossils that are of limited scientific or conservation significance.

The tetrapod fossils include several occurrences, variously isolated or clumped, of robust, often weathered and sun-cracked bones of dinocephalian therapsid or pareiasaur reptile affinity that are mostly unidentifiable (Figs. 51 to 52). These are usually associated with pedocrete horizons composed of brownish ferruginous concretions and occur among surface float (*i.e.,* not embedded within bedrock). Identifiable skull material of biostratigraphically important dinocephalians such as *Criocephalosaurus* has not been recorded within the Grid Connection project area but is known in the broader JESSA WEF project area. Small dicynodont skulls and postcranial remains are locally common within the Poortjie Member where they are usually enclosed in greyish palaeocalcrete concretions (Figs. 54 to 60). The small (*c.* 15-30 cm wide), straight to curved and often gently inclined tetrapod burrow casts observed are probably attributable, for the most part, to small-bodied dicynodonts such as *Diictodon*, whose skeletal remains frequently occur in the same beds (Figs. 61 & 62). Invertebrate trace fossils of the *Scoyenia* Ichnofacies are associated with damp substrates around floodplain pond margins where they may occur with wave rippled and microbial mat-textured sandstone palaeosurfaces, as well as casts of reedy plant stems (sphenophyte ferns or horsetails). Body fossils of the *Glossopteris* Flora, including petrified wood, are not well-represented here.

Vertebrate fossils of high palaeontological interest from the Poortjie Member which are illustrated here include (1) the possibly complete skull of a crocodile-like, rhinesuchid temnospondyl amphibian (Figs. 48 & 49), (2) the incomplete jaws of a large-fanged gorgonopsian predator (Fig. 46), (3) two mandibles of the moderately robust dicynodont *Endothiodon* (Fig. 47), as well as (4) a few well-preserved skulls of small dicynodonts belonging to genera other than the ubiquitous *Diictodon* (Figs. 54 & 55). A high proportion of these more important tetrapod fossils come from dissected hilly terrain with good Poortjie Member mudrock exposure which is found close to the boundary between Farm 432 in the south and Farm 10/170 in the north. This more palaeosensitive area also overlaps the previous type area for the *Pristerognathus* Assemblage Zone (Fig. 45). Several of the scientifically important fossils recorded during the PIA fieldwork – as noted in the fossil tables in Appendix 2 - have now been formally collected by the ESI (Wits University) as part of an on-going Karoo biostratigraphy research project led by Professor Bruce Rubidge. **Consequently, they do not require palaeontological mitigation triggered by the proposed JESSA project** (The relevant fossil sites are still shown on satellite maps in Figures 64 and 65).

The only fossils recorded from the Late Caenozoic superficial deposits within the JESSA Grid Connection project area are locally dense assemblages of calcretized rhizoliths (plant root casts) and/or termite burrows within older alluvial deposits along major drainage lines such as the Gamka River (Fig. 63). Such trace fossils are of widespread occurrence in the Great Karoo region and are of low scientific / conservation significance. There is also potential for Late Pleistocene mammalian remains (bones, teeth, horncores) as well as non-marine molluscs within such consolidated older alluvium. One case of human skeletal remains within Holocene flood deposits is known from the JESSA WEF project area (part of separate respective BA processes and addressed in a standalone PIA Report), **but this has now been destroyed by recent flood erosion and so no mitigation is required for this site**.

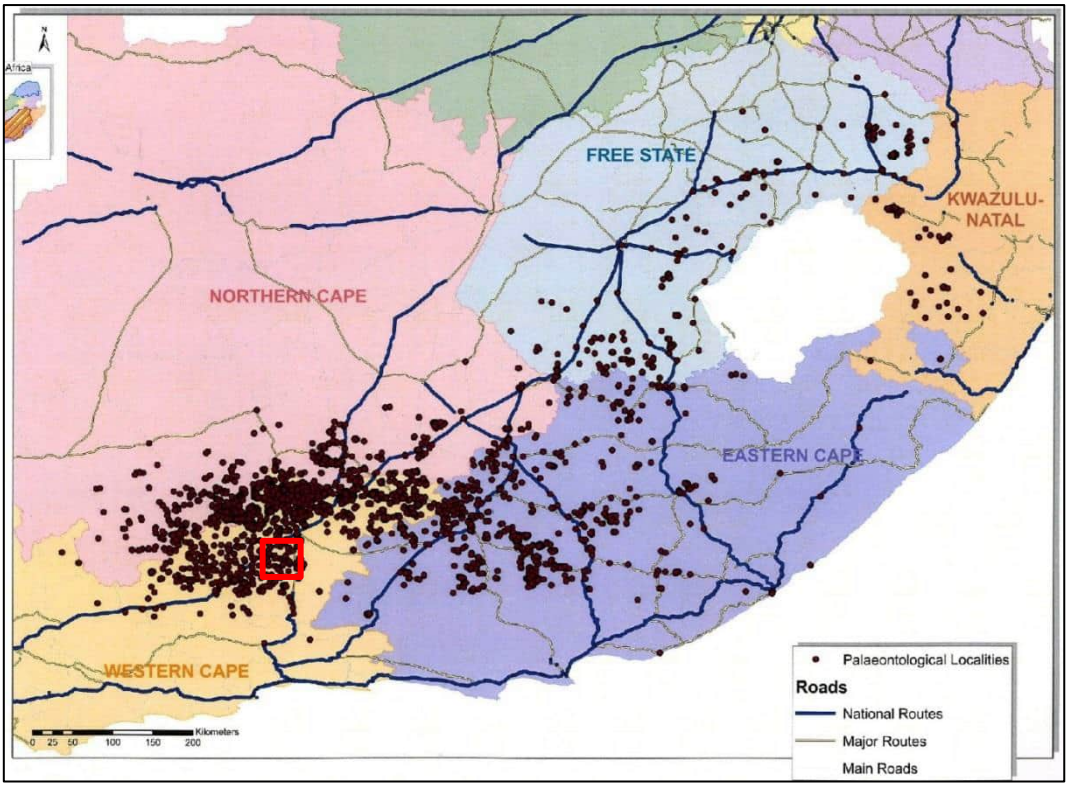

Figure 39: Distribution of recorded vertebrate fossil sites within the he Main Karoo Basin (modified from Nicolas 2007). The approximate location of the JESSA WEF and Grid Connection project area to the southwest of Beaufort West is approximately indicated by the small red rectangle. The high density of recorded fossil sites to the west of the N12 here is notable.

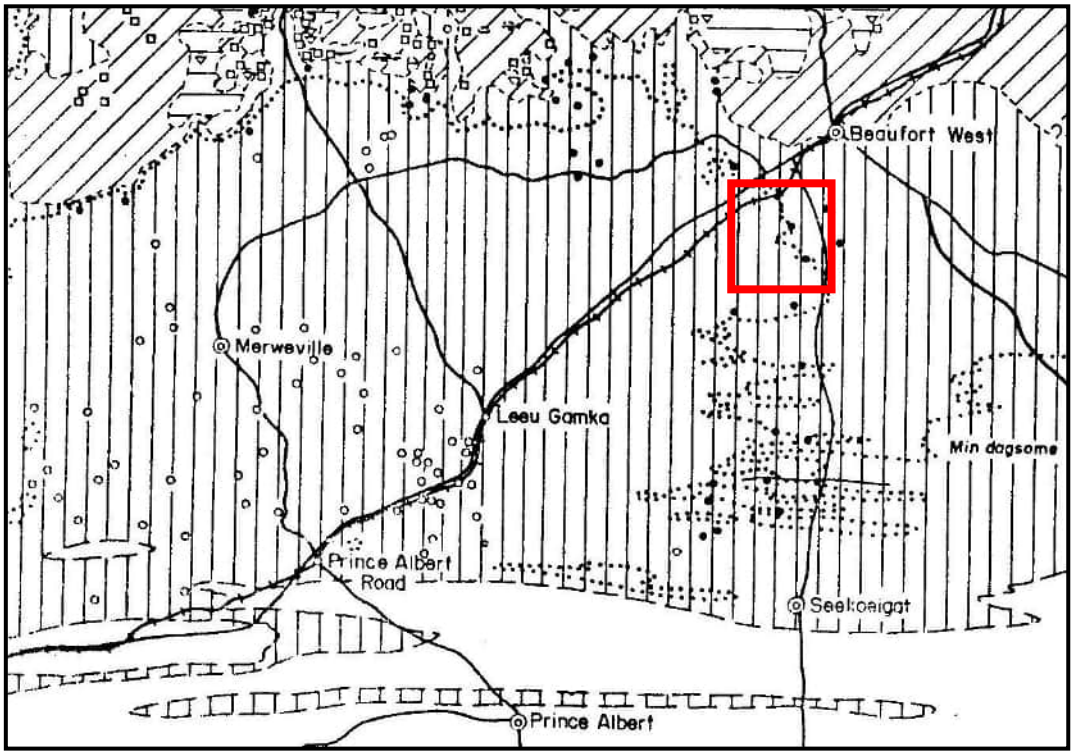

Figure 40: Vertebrate fossil localities within the Lower Beaufort Group in the region southwest of Beaufort West where the boundary between the Abrahamskraal and Teekloof Formations is highly folded (dotted line). Numerous Pristerognathus Assemblage Zone fossils (black dots) are associated here with outcrops of the Poortjie Member (lowermost Teekloof Formation) (Map abstracted from Keyser & Smith 1977-78). The paucity of fossil records east

of the N12 tar road reflects the generally poor bedrock exposure in the area compared with more dissected terrain to the west of the road.

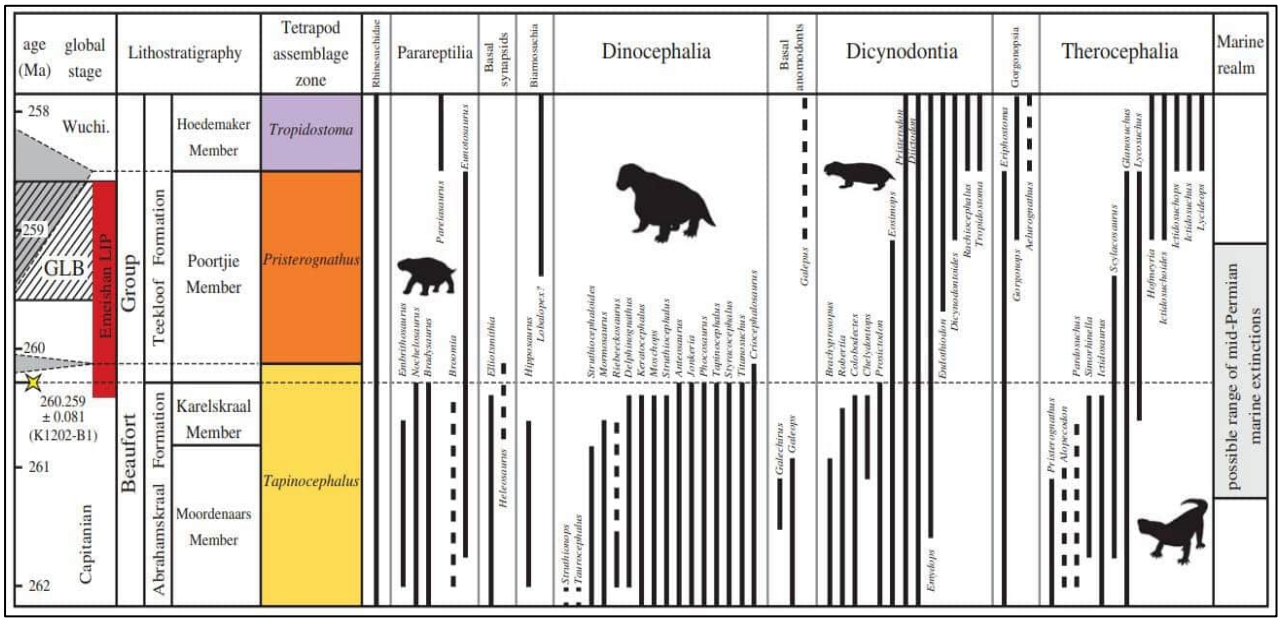

Figure 41: Chart showing the ranges of known terrestrial tetrapod genera from the Middle to Late Permian of the Main Karoo Basin (From Day et al. 2015b). The boundary between the Abrahamskraal and Teekloof Formations is associated with a catastrophic global mass extinction event at the end of the Capitanian Stage (c. 260 Ma) that has been dated here on the basis of a tuff horizon close to the contact of the Karelskraal and Poortjie Members (yellow star). Key victims of the extinction event were almost all the large-bodied dinocephalians and pareiasaur parareptiles as well as many (but not all) dicynodonts and therocephalians.

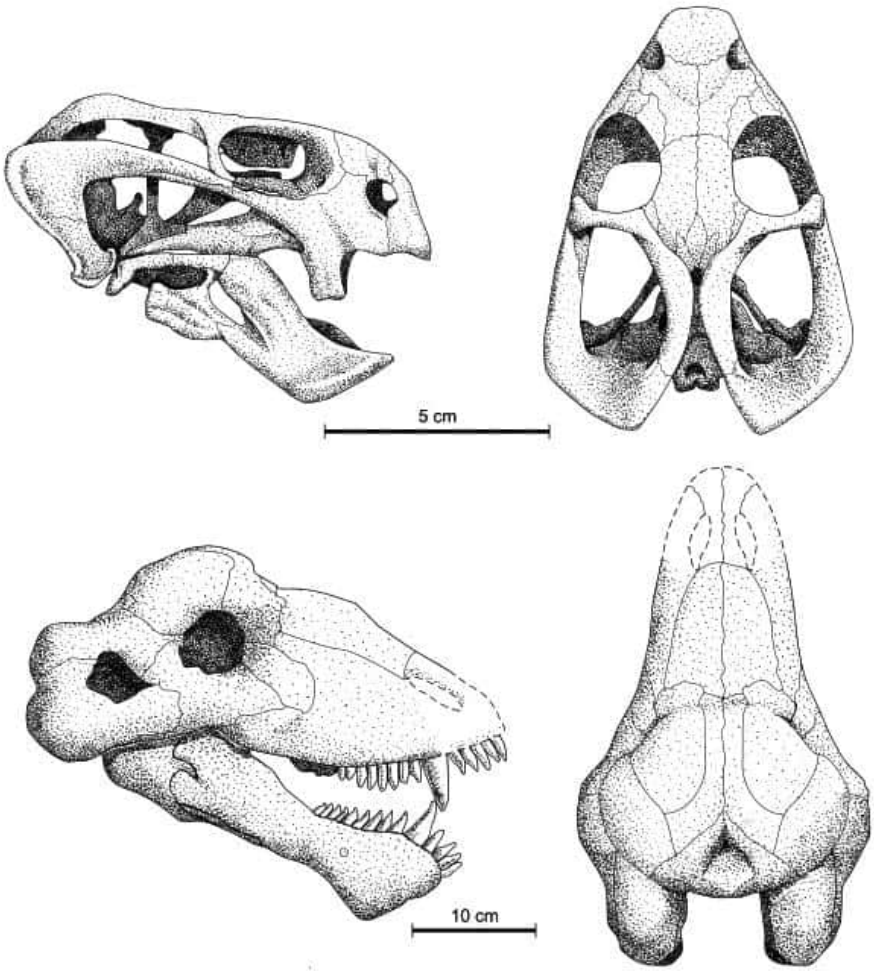

Figure 42: Skulls of two key fossil therapsid tetrapods from the upper part of the Tapinocephalus Assemblage Zone – the small-bodied dicynodont Diictodon (top) and the large-bodied dinocephalian Styracocephalus. Note the very thick cranial roof in the latter, a possible adaptation for head-butting shown by many tapinocephalid dinocephalians.

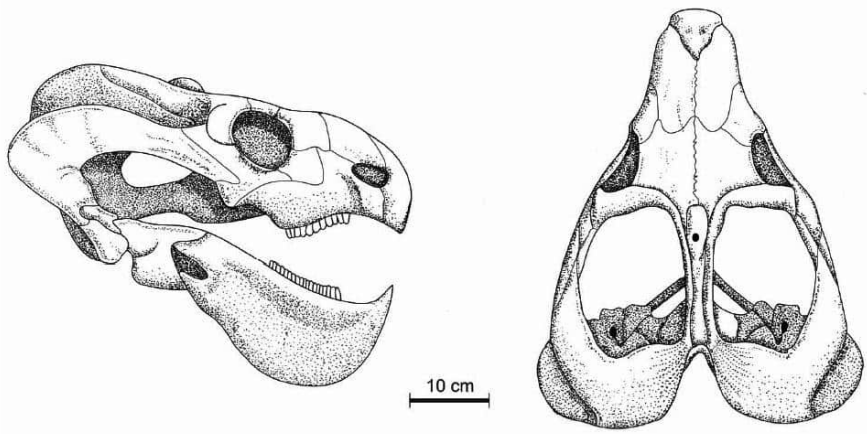

Figure 43: Skull of the robust, moderately large dicynodont Endothiodon which occurs within the middle to upper part of the Poortjie Member near Beaufort West (From Day & Smith 2020).

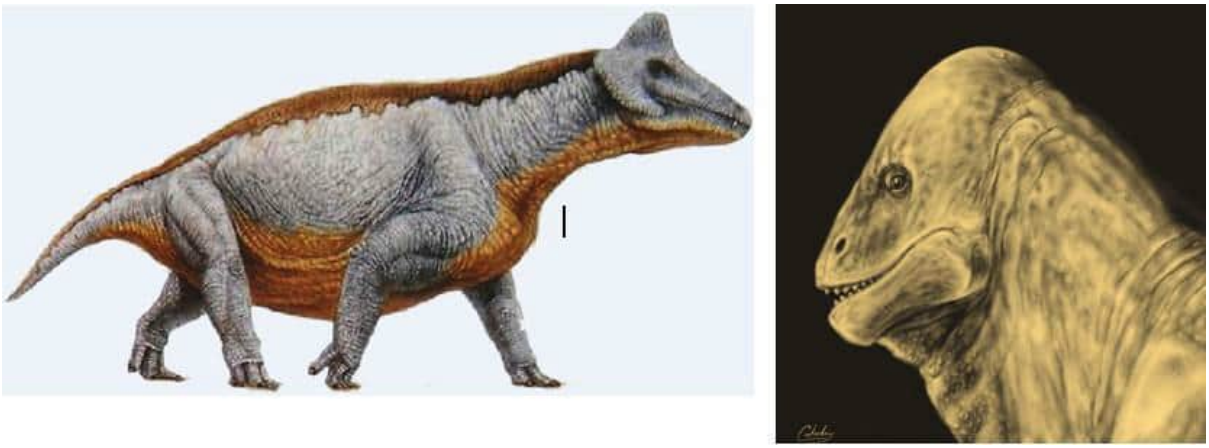

Figure 44: Artist's reconstructions of the ill-favoured late Middle Permian dinocephalians Styracocephalus (left) and Criocephalosaurus (right). One or both these taxa may occur within the JESSA WEF and Grid Connection project area. Criocephalosaurus is of special interest as one of the last surviving dinocephalians, several examples of which have been recorded recently within the lower Poortjie Member in the Beaufort West region.

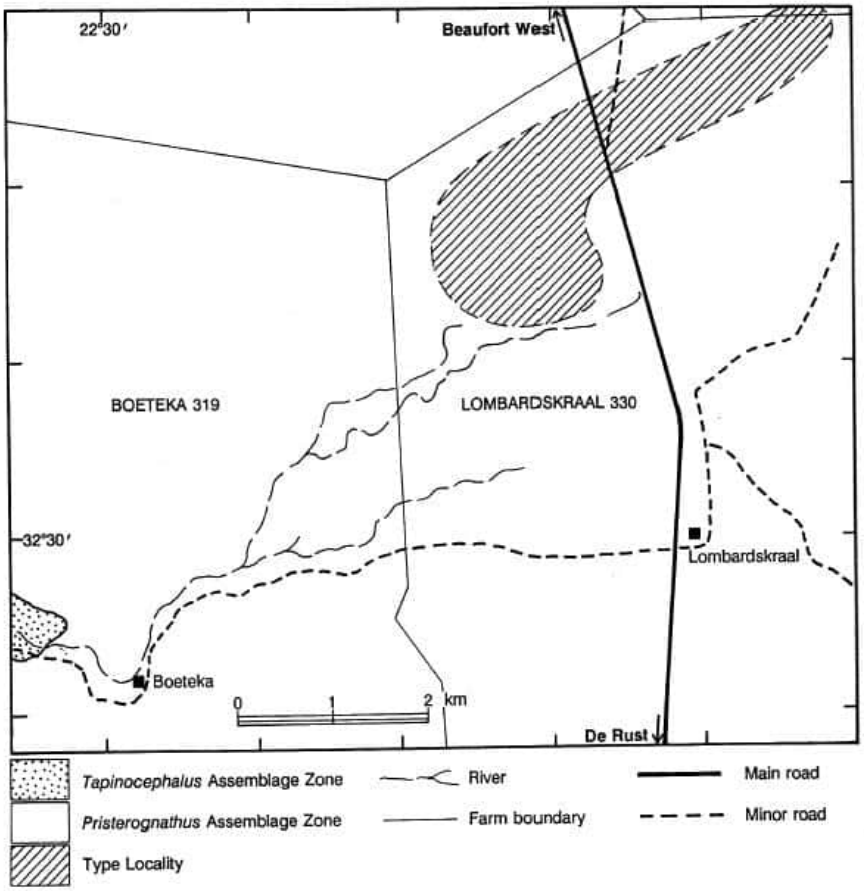

Figure 45: The original type area for the now-defunct Pristerognathus Assemblage Zone (AZ) extended across the N part of Farm Lombards Kraal 330 (From Smith & Keyser 1995b). This AZ has now been largely incorporated into the new Endothiodon AZ for which a new type area has been designated elsewhere (Day & Smith 2020). The hatched area shown here – which overlaps with the grid connection project area on Farm 432 - remains of special palaeontological interest.

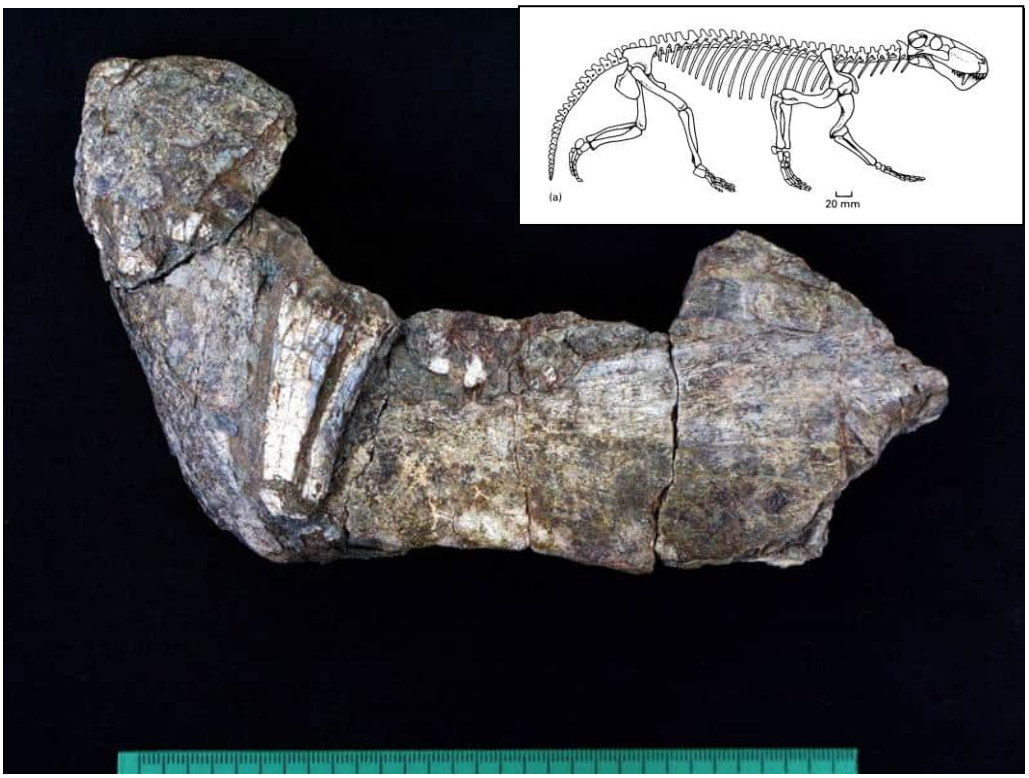

Figure 46: Lower jaw and partial snout of a rare gorgonopsian carnivore with enlarged upper canine, upper Poortjie Member, Farm Weltevreden 10/170 (Loc. 011) (scale in cm and mm) (from Almond 2014). This specimen has been collected by Wits University. Inset shows reconstruction of a gorgonopsian skeleton.

Figure 47: Lower jaw of the robust, medium-sized dicynodont Endothiodon, upper Poortjie Member, Farm Weltevreden 10/170 (Loc. 011) (from Almond 2014). This specimen, one of two mandibles from the same locality, has been collected by Wits University. Inset shows a complete endothiodont skeleton.

Figure 48: Possibly complete skull of a large temnospondyl amphibian seen in oblique posyterodorsal view showing the characteristic complex surface ornamentation of dermal bones (scale in cm), middle Poortjie Member, Farm 232 (Loc. 218). This specimen is to be collected by the ESI (Wits University).

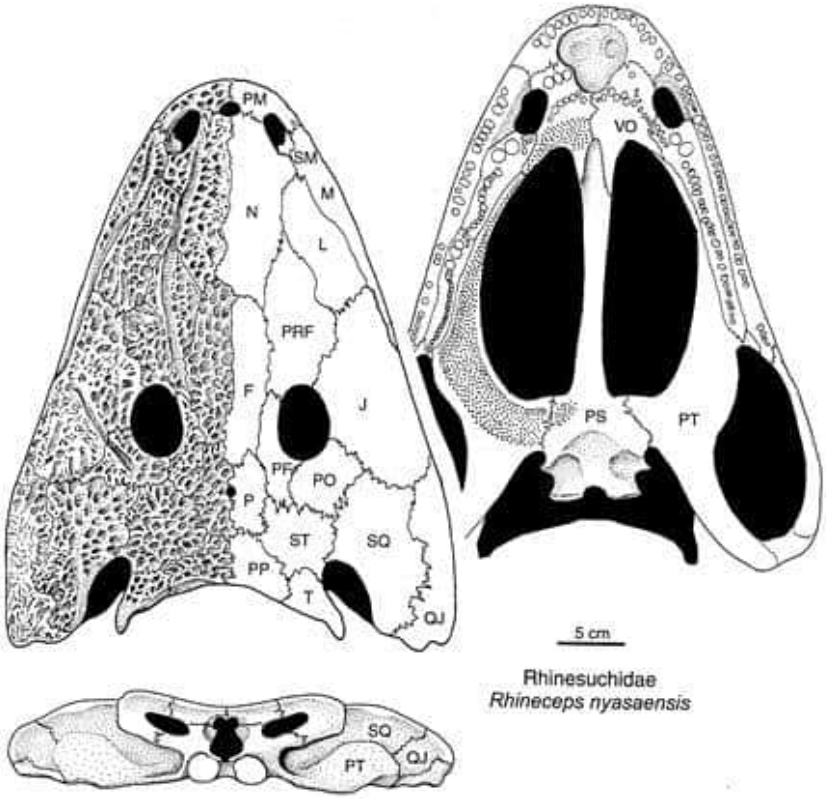

Figure 49: Reconstruction of the dorso-ventrally flattened skull of a rhinesuchid temnospondyl – the group of crocodile-like amphibian predators to which the skull illustrated above belongs (from Carroll 2009).

Figure 50: Block of well-indurated bone breccia containing a high concentration of bone shards – possibly reworked from sun-cracked skeletal material on the floodplain, Poortjie Member, Farm 432 (Loc. 219) (scale in cm and mm).

Figure 51: Two sun-cracked fragments of robust bone (possibly dinocephalian or pareiasaur) among surface float, having weathered out from a ferruginous pedocrete horizon in the Abrahamskraal Formation on Farm Weltevreden 10/170 (Loc. 760) (scale in cm).

Figure 52: 20 cm-long fragment of robust, highly-weathered bone – pareiasaur or dinocephalian - in surface float overlying the upper Abrahamskraal Formation (or possible lower Poortjie Member) on Farm Weltevreden 10/170 (Loc. 372).

Figure 53: Block of weathered robust bone (c. 11.5 cm across) among ferruginous pedcrete concretions of uppermost Abrahamskraal Formation or lower Poortjie Member on Farm Weltevreden 10/170 (Loc. 368).

Figure 54: Skull of a small-bodied dicynodont with a broad intertemporal region (possibly Pristerodon) seen in dorsal view, embedded within a pedogenic calcrete horizon, Poortjie Member, Farm Weltevreden 10/170 (Loc. 021) (scale in cm and mm) (From Almond 2014).

Figure 55: Skull of a small-bodied dicynodont (probably Diictodon) preserved within a pedocrete concretion, Poortjie Member, Farm Weltevreden 10/170 (Loc. 017) (scale in cm and mm).

Figure 56: ***Small dicynodont skull (c. 8 cm long) seen in dorsal view, probably suncracked and enclosed within a pedogenic calcrete concretion, Poortjie Member, Farm Weltevreden 10/170 (Loc. 370).***

Figure 57: Cluster of pedocrete concretions containing skulls and postcranial remains of small-bodied dicynodonts, middle Poortjie Member, Farm Weltevreden 10/170 (Loc. 387) (scale in cm and mm).

Figure 58: Cluster of pedocrete concretions containing skulls and postcranial remains of small-bodied dicynodonts, middle Poortjie Member, Farm Weltevreden 10/ 170 (Loc. 385) (scale in cm and mm).

Figure 59: Partial skull of a small dicynodont showing well-developed canine tusk, 4.5 cm-wide pedogenic concretion in the Poortjie Member, Farm Weltevreden 10/ 170 (Loc. 380).

Figure 60: Pedogenic calcrete concretions containing skull and post-cranial remains of a small-bodied dicynodont, Poortjie Member, Farm Weltevreden 170/10 (Loc. 743) (scale in cm).

Figure 61: Stream bank exposure of hackly-weathering mudrocks of the Poortjie Member, Farm Weltevreden 170/10 (Loc. 743) containing sandstone casts of small, gently inclined tetrapod burrows that are probably attributable to dicynodonts (arrowed) (hammer = 30 cm).

Figure 62: Inclined cast of a small tetrapod burrow within Poortjie Member bedrocks on the bed of the Lombaardskraal se Loop, Farm 432 (Loc. 766) (hammer = 30 cm).

Figure 63: Exposure of calcretised older alluvium on the southern banks of the Gamka River containing dense assemblages of calcretised rhizoliths (plant root casts) and / or termite burrows, Farm Weltevreden 170/10 (hammer = 30 cm).

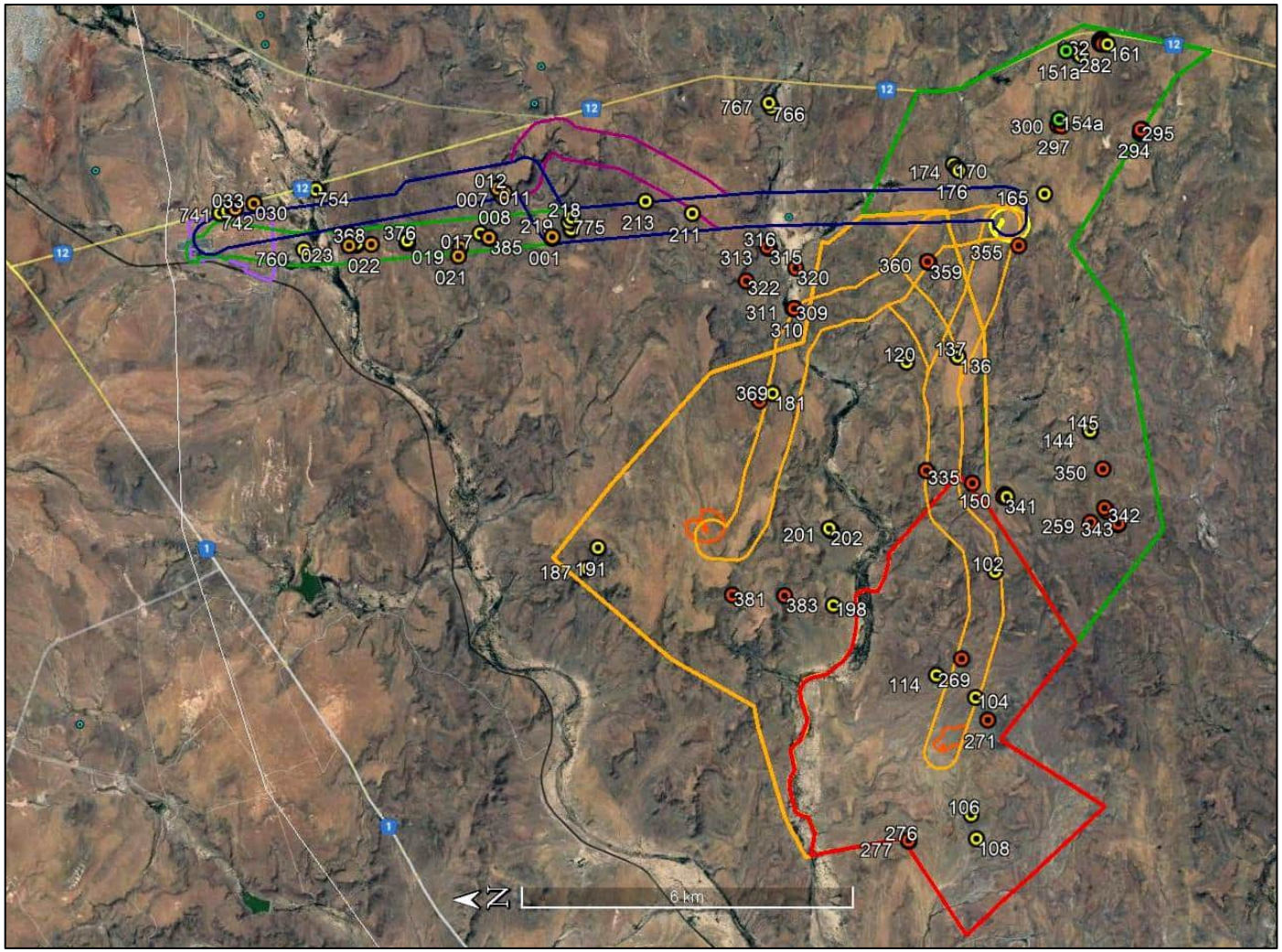

Figure 64: Google Earth© satellite images of the JESSA M Grid Connection feeding into the existing Droërivier MTS, showing numbered fossil sites recorded during recent PIA palaeontological surveys (2014, 2020, 2021). Details of each fossil site are tabulated in Appendix 2 (The different colours of the site symbols reflect different phases of the palaeontological site visits). See Figures 5 and 8 for a key to the grid connection options depicted. Grid Corridor Alt 1 (dark green) contains the most recorded fossil sites, with fewer sites in the Alt 3 (dark blue) corridor and very few in the Alt 2 (magenta) corridor. Comparatively few fossil sites are recorded within the WEF connecting grid corridors (orange). The various substation sites (orange, yellow) and Droërivier MTS expansion area (purple) contain no known sites. **N.B.** ***North is towards the LHS of the image.***

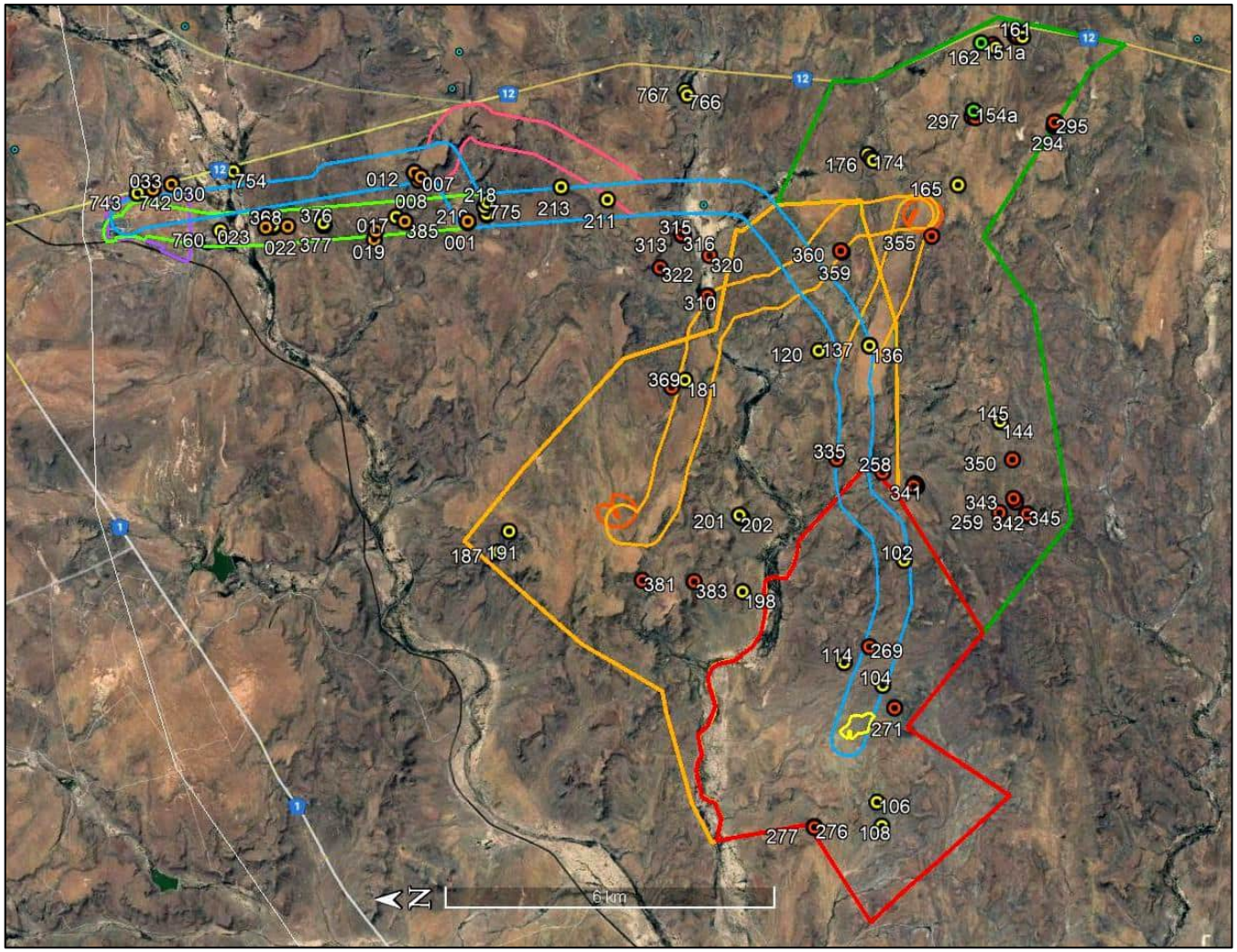

Figure 65: Google Earth© satellite images of the JESSA S Grid Connection feeding into the existing Droërivier MTS, showing numbered fossil sites recorded during recent PIA palaeontological surveys (2014, 2020, 2021). Details of each fossil site are tabulated in Appendix 2 (The different colours of the site symbols reflect different phases of the palaeontological site visits). See Figures 3 and 6 for a key to the grid connection options depicted. Grid Corridor Alt 1 (pale green) contains the most recorded fossil sites, with fewer sites in the Alt 3 (blue) corridor and very few in the Alt 2 (magenta) corridor. Comparatively few fossil sites are recorded within the WEF connecting grid corridors (orange). The various substation sites (orange, yellow) and Droërivier MTS expansion area (purple) contain no known sites. **N.B.** ***North is towards the LHS of the image.***

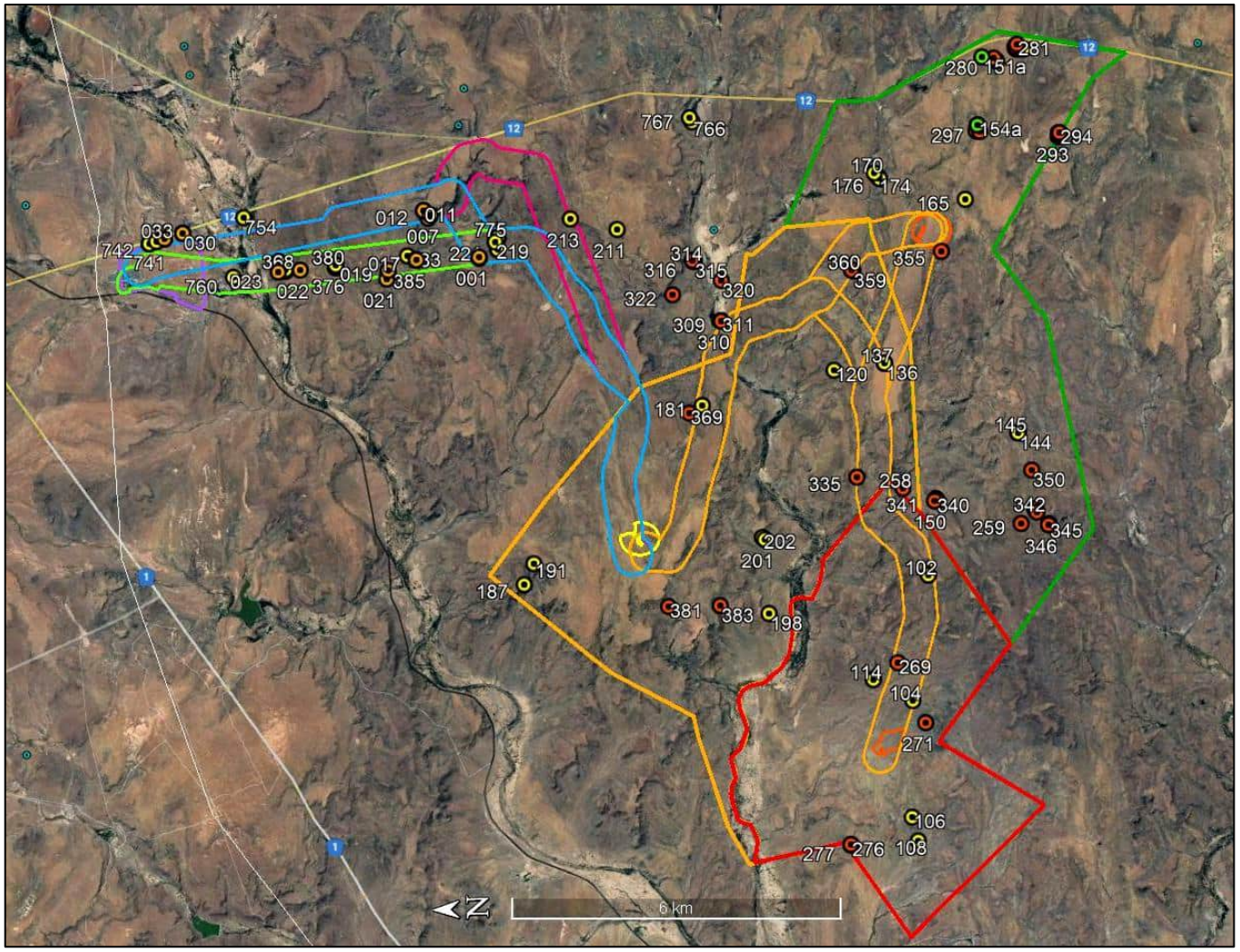

Figure 66: Google Earth© satellite images of the JESSA Z Grid Connection feeding into the existing Droërivier MTS, showing numbered fossil sites recorded during recent PIA palaeontological surveys (2014, 2020, 2021). Details of each fossil site are tabulated in Appendix 2 (The different colours of the site symbols reflect different phases of the palaeontological site visits). See Figures 4 and 7 for a key to the grid connection options depicted. Grid Corridor Alt 1 (pale green) contains the most recorded fossil sites, with fewer sites in the Alt 3 (blue) corridor and very few in the Alt 2 (magenta) corridor. Comparatively few fossil sites are recorded within the WEF connecting grid corridors (orange). The various substation sites (orange, yellow) and Droërivier MTS expansion area (purple) contain no known sites. **N.B.** ***North is towards the LHS of the image.***

6. SENSITIVITY MAPPING

Based on the potentially fossiliferous Beaufort Group bedrocks represented here, almost the entire combined JESSA WEF and Grid Connection project area near Beaufort West has been provisionally assigned a VERY HIGH PALAEOENSITIVITY rating in terms of palaeontological heritage by the national web-based DFFE Screening Tool (See Appendix 3), and a VERY HIGH rating on the SAHRIS palaeosensitivity map. Paradoxically, the draft Phase 2 Heritage Scoping Report for the Aberdeen and Beaufort West REDZ5 area by Van der Walt (2019) only asserts that "*Small sections in the focus area are of medium palaeontological sensitivity*" and assigns an overall Medium Sensitivity to this REDZ (This assessment is currently being challenged, however).

The present combined desktop- and field-based palaeontological heritage study of the JESSA WEF and Grid Connection project area suggests that, *in practice*, much or most of the area is LOW PALAEOSENSITIVITY due to (1) the very sparse occurrence here of fossil sites of scientific and/or conservation value as well as (2) the extensive cover by low-sensitivity superficial sediments in areas of low relief. However, occasional *small*, scattered and largely unpredictable fossil sites of high palaeosensitivity and scientific interest certainly do occur here, only some of which have been recorded during the reconnaissance-level field surveys to date. **None of these sites is regarded as a "No-Go" Area or need to be taken into consideration during the design phase of the Grid Connection projects, however. If threatened by development (*i.e.,* located < 20 m from development footprint), they can be effectively mitigated by professional palaeontological recording and sampling / collection in the pre-construction phase**.

Almost all known fossil sites refer to the Palaeozoic bedrocks of the Lower Beaufort Group but important fossils or subfossils (*e.g.,* mammalian remains) might also occur within older, consolidated alluvial deposits along major drainage lines. The consolidated older alluvial deposits and any fossils they might contain will be entirely or largely protected within standard riverine ecological buffer zones.

The VERY HIGH palaeosensitivity of the JESSA Grid Connection project areas suggested by the DFFE Screening Tool is accordingly *contested* here (Appendix 3). There are no designated Very High Sensitivity or "No-Go" areas which need to be taken into account in the planning phase of the Jessa Grid Connection developments.

7. SPECIALIST FINDINGS ASSESSMENT OF IMPACTS

Existing impacts on palaeontological heritage within the combined Jessa Grid Connection project area include the following:

(1) low-level disturbance and damage / destruction of fossils exposed at surface due to current small stock and game farming; and
(2) natural weathering and erosion processes that continually expose and eventually destroy fossils originally embedded within sedimentary bedrocks and superficial sediments here.

Impacts due to illegal or legal fossil collection are probably minor.

7.1 Brief comparison of grid connection options

A sparse scatter of recorded fossil sites lies within the provisional corridors for the grid connection options for the respective grid connection projects (including the WEF grid connecting corridors), where these traverse the combined JESSA WEF project area (Figs. 64 & 66). Almost all of these fossil sites are of moderate to low palaeontological interest and all of them can potentially be mitigated, if necessary, in the preconstruction phase through professional recording and collection.

To the north, a higher concentration of fossil sites – including several valuable fossil specimens - is mapped along the Alt 1 grid connection corridor for all three JESSA Grid Connection projects across the northern sector of Farm 432 and Farm 10/170, in part because of higher levels of mudrock exposure here. As already noted, the dissected terrain spanning the border between these two land parcels is already recognised in the literature as being of special palaeontological heritage interest (Fig. 45), while the gravelly sandstone plateau terrain further south on Farm 432 is comparatively barren palaeontologically.

Alternative grid corridors feeding into a more easterly Alt2 and Alt 3 corridors contain fewer known fossil sites, in part because the bedrocks on the eastern sector of Farm 10/170 are more extensively mantled by unfossiliferous Late Caenozoic cover sediments than further to the west.

Given the reconnaissance level of palaeontological recording within the huge project area, however, and the high potential for effective mitigation of fossil finds in all cases, there is **no marked preference for either the preferred or the alterative sets of grid connection options under consideration on palaeontological heritage grounds**. This is true for all three Jessa Grid Connection projects.

7.2 MTS expansion area

The Lower Beaufort Group (Poortjie Member) bedrocks underlying the Droërivier MTS are very poorly exposed due to the thick mantle of low palaeosensitivity silty, sandy to gravelly alluvial sediments of the Gamka – Droerivier confluence system underlying the flat, often disturbed terrain here (Figs. 35 to 38). Locally the alluvium includes cobbly to boulder river gravels (probably relict bars, terrace gravels), with large areas featuring a sparse to dense veneer of poorly sorted (cobble to boulder sized), angular to well-rounded, eluvial gravels of dolerite, wacke, hornfels and quartzite, including common stone artefacts. Pale zones on satellite images are sandy alluvial patches with signs of aeolian reworking. Better bedrock exposure is seen on the more dissected western and eastern margins of the area, for example in the vicinity of the old railway station.

No fossil sites have been recorded so far within the proposed MTS expansion area, which is generally of LOW palaeosensitivity. As such, there are no fatal flaws associated with the potential expansion / upgrade from a palaeontological heritage viewpoint and this should be allowed to proceed.

7.3 Impact assessment

Significant impacts on palaeontological heritage are only anticipated in the construction phase of the proposed JESSA Grid Connection projects. No further significant impacts are expected in the operational and decommissioning phases of the respective grid connection developments). 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 grid connection project area, mainly due to ground clearance and bedrock excavations for electrical pylon footings, access / service roads, switching stations and temporary laydown areas.

The palaeontological heritage impact significance of the proposed JESSA M, JESSA S and JESSA Z Grid Connection projects, both before and after mitigation, is assessed in Table 3 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 Grid Connection projects entail *direct negative* impacts to palaeontological heritage resources that are confined to the development footprints (*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 JESSA 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 JESSA Grid Connection projects, 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 **Medium (negative)** before mitigation. With full implementation of the palaeontological mitigation measures outlined in Section 8, the impact significance may fall to **Very Low (negative).** This assessment applies to all the grid connection infrastructure listed in the project description, including the switching stations and possible MTS expansion (Section 4). It should also be noted that this assessment applies equally to each separate grid connection application (*viz*. Jessa M, Jessa S and Jessa Z Grid Connections), given their very similar geological and palaeontological contexts.

In view of (1) the similar geological, and hence palaeontological, context of all the grid connection corridors under consideration for the respective grid connection projects, as well as (2) the high potential for effective mitigation of sensitive fossil sites within each corridor, **there is no marked preference for any specific corridor among the grid connection options under consideration for each of the three JESSA Grid Connection projects**.

Although palaeontological field surveying within the extensive combined 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 substantial fossil data from the scientific literature as well as from several previous PIAs in the broader region (*viz*. Droerivier and Bulskop Solar projects, Nuweveld Wind Farm grid connection project, Beaufort West and Trakas Wind Farm projects), as well as from the two (2)-week palaeontological field study of the combined JESSA Project area.

Table 3: Assessment of potential palaeontological heritage impacts of the proposed JESSA Grid Connection Projects (JESSA M, JESSA S, JESSA Z) near Beaufort West (Construction Phase) - preferred as well as alternative options

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	Medium	Low
Probability	Probable	Possible
Significance	Medium -	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	Moderate. Most fossils recorded from the broader project area are of widely occurring forms within the outcrop areas of the formations concerned but a few are v. rare.
Degree to which impact can be mitigated	Moderate to High. 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.
Mitigation Actions	
The following measures are recommended	• Cross-checking of final footprint against available palaeontological databases, satellite imagery by professional palaeontologist. • Pre-construction walkdown of potentially sensitive, unsurveyed sectors of footprint by professional palaeontologist. • Palaeontological recording and sampling / collection of valuable fossils threatened by development (<20 m from footprint). • Implementation of Chance Fossil Finds Protocol by ECO / ESO during Construction Phase with recording and collection of significant new finds by professional palaeontologist.
Monitoring	
The following monitoring is recommended:	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.

As mentioned, no further significant impacts are expected in the operational and decommissioning phases of the respective grid connection developments.

7.4 Alternatives

7.4.1 Grid Connection

As mentioned in section 4.3, a site area of up to approximately 30ha has been assessed for the switching station portion of the substation and connection of the associated powerlines which form part of each Grid Connection project.

In addition, as part of the site area, three 132kV powerline route alternatives have been assessed for each Grid Connection project, to link each proposed Jessa WEF project to the existing Eskom Droërivier MTS. One of the above-mentioned powerline corridor route alternatives will be required per Grid Connection project. Three 132kV WEF connecting grid corridors to link the respective Jessa WEF projects (*i.e.* Jessa M – Jessa S; Jessa Z – Jessa M and Jessa Z to Jessa S) have also been assessed and are being proposed for authorisation.

Powerline corridors with widths of 600m (*i.e.* 300m on either side of centre line) are being considered and assessed for the powerline route alternatives and WEF connecting grid corridors, to allow flexibility when routing the proposed powerlines within the authorised corridors.

As mentioned, all three WEF connecting grid corridors will need to be authorised by the DFFE, to allow the respective Jessa WEF projects to connect to the national grid, should one of the proposed grid connection infrastructure projects not received EA (see section 4.3).

Given (1) the similar geological, and hence palaeontological, context of all the grid connection corridors under consideration for the respective grid connection projects, as well as (2) the high potential for effective mitigation of sensitive fossil sites within each corridor, **there is no marked preference for any specific grid connection corridor among the options under consideration for each Jessa Grid Connection project**. The impact assessment provided in Table 3 applies equally to all grid connections under consideration. From a palaeontological heritage viewpoint, none of the grid connection options under consideration is fatally flawed and there are no objections to their authorisation.

7.4.2 Main Transmission Substation Expansion

In addition, as an alternative to connecting directly to the existing Eskom Droerivier MTS, ESA will explore the possible expansion of the MTS. A 20-30 ha area has therefore been assessed for this purpose, within Portion 10 of Farm Weltevreden near the existing Eskom MTS (Purple polygon in Figures 64 to 66)).

The palaeontological heritage sensitivity of the MTS expansion area is LOW, due to the thick cover by largely unfossiliferous alluvial sediments and eluvial gravels (Section 7.2). **No fossil sites have been recorded here and the impact significance of the proposed MTS expansion is rated as Low (negative)**. As such, there are no fatal flaws associated with the potential expansion / upgrade and this should be allowed to proceed.

7.4.3 "No-Go" Alternative

The "no-go" alternative is the option of not constructing the JESSA Grid Connection projects, 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 would probably, on balance, have a *neutral* impact on palaeontological heritage. The likely loss of local heritage resources through grid infrastructure 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 foregone. 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 potential scientific collection and study.

7.5 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).

The Aberdeen and Beaufort West region has recently been formally gazetted as a Renewable Energy Development Zone (REDZ) (REDZ5; *cf* heritage review by Van der Walt, 2019) and has attracted a substantial number of renewable energy projects. Approved renewable energy applications identified within, or just outside, a 30-35km radius of the present JESSA project site (Fig. 67) include the following projects:

- Beaufort West Photovoltaic Park - *cf* Almond (2011) and Bamford (2021) for desktop PIAs for this project area. - **An updated PIA for the solar project here is not available**.

- Beaufort West Solar Power Plant Site 2 – *cf* desktop PIA by Almond (2011) for the farm Steenrotsfontein 168. - **An updated field-based assessment for the project area is not available**.
- Mainstream Beaufort West & Trakas WEFs - *cf* combined desktop and field-based PIA reports by Almond (2018, 2021g).

In addition to the three proposed JESSA WEFs , other relevant renewable energy projects (mostly unauthorized) in the Beaufort West region for which field-based PIA studies have been conducted by the author include the Gamma – Omega 765kV transmission line (Almond 2010), Droefontein Solar Facility (Almond 2014), Kwagga 1-2 Wind Farms (Almond 2021a-c), Koup 1 & 2 Wind Farms (Almond 2021d-e), Heuweltjies and Kraaltjies Wind Farms (Almond, in prep.), Bulskop PV Cluster (Almond 2021f) and the Nuweveld Grid Connection (Almond 2020g).

Cumulative impacts on palaeontological heritage due to the *authorized* renewable energy projects listed above cannot yet be accurately assessed because field-based PIA assessments for the solar projects are not available. However, **based on the author's experience in the Beaufort West region, Moderate to Low (negative) significance impacts without mitigation are anticipated in all cases, probably falling to Low or Very Low (negative) significance after mitigation**.

Anticipated cumulative impacts of the authorized renewable energy projects listed above as well as the JESSA WEF and Grid Connection projects are assessed here as **Medium (negative)** without mitigation (Table 4). Overall impact significance may fall to **Low (negative)** 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 fully implemented (*N.B.* This is inherently unpredictable). 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 Great Karoo region near Beaufort West - including the proposed JESSA WEF and associated Grid Connection projects – fall within acceptable limits, *provided that* all recommended mitigation recommendations for these projects are fully implemented**.

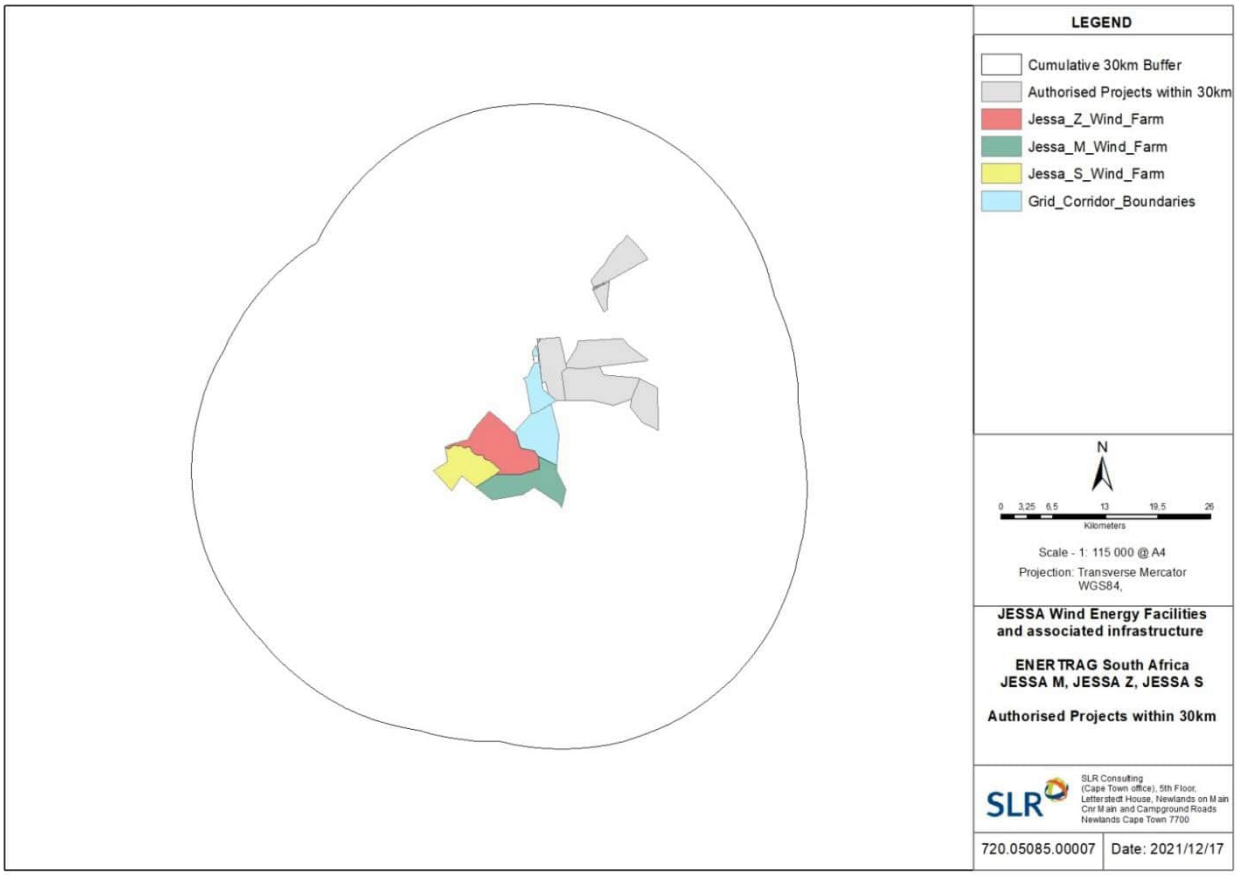

Figure 67: Map showing authorised renewable energy projects within a 35 km radius of the JESSA WEF and Grid Connection projects near Beaufort West

Table 4: Assessment of potential cumulative palaeontological heritage impacts relating to the proposed JESSA 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 grid connection project footprints, mainly due to ground clearance and excavations.**		
Type of Impact	**Direct**	
Nature of Impact	**Negative**	
Phases	**Construction**	
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Low
Duration	Permanent	Permanent
Extent	Site	Site
Consequence	Medium	Medium
Probability	Probable	Possible
Significance	Medium -	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 to Medium. Most fossils recorded from the project area are of widely occurring forms within the outcrop areas of the formations concerned but a few are v. rare.
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.
Mitigation Actions	
The following measures are recommended	N/A – it is the specialist's professional opinion that mitigation of cumulative impacts cannot be effectively specified, since they result from several independent renewable energy projects, into which the specialist has no direct input.
Monitoring	
The following monitoring is recommended:	N/A – it is the specialist's professional opinion that monitoring of cumulative impacts cannot be effectively specified, since they result from several independent renewable energy projects, into which the specialist has no direct input.

8. MITIGATION AND EMPr REQUIREMENTS

A substantial number of recorded fossil sites fall within the assessment corridors for the various Grid Connection options under consideration (Figs. 64 & 66). However, the majority of these sites involve poorly-preserved and fragmentary fossil material (*e.g.* unidentifiable, highly weathered fragments of postcranial bones) or very common fossil forms (e.g. many trace fossils) that are of low scientific and/or conservation significance (See Provisional Field Ratings listed in Appendix 2). Several of the most important vertebrate fossils recorded have already been collected by the ESA (Wits University), while most of the remainder are likely to be situated > 20 m from the final grid connection footprint and will probably not be impacted during the construction phase. In sum, mitigation of the majority of recorded fossil sites will not be necessary. However, given the reconnaissance level of palaeontological surveys conducted to date, the potential for construction phase impacts on hitherto unrecorded scientifically important fossils cannot be entirely discounted.

The following pre-construction and construction phase mitigation measures regarding palaeontological heritage resources are therefore proposed here for the JESSA Grid Connection projects:

1. The final, authorized layout of the JESSA Grid Connection projects must be cross-checked against the available fossil database and other relevant resources (*e.g.,* satellite imagery, geological maps) by the palaeontological specialist, who must make specific recommendations for pre-construction phase mitigation, if any proves necessary.

2. A focused, pre-construction walkdown of the final gridline alignments must be undertaken by a suitably qualified palaeontological specialist, focusing primarily on unsurveyed sectors of potential or inferred high palaeontological sensitivity. Any significant, potentially threatened, known or new fossil sites are to be fully recorded and, if warranted, judiciously sampled or collected under a Fossil Collection Permit from Heritage Western Cape.

3. High sensitivity fossil sites close to (< 20 m) the project footprints which cannot, or should not, be collected on palaeontological conservation grounds (none of which have been identified to date) must be mitigated through avoidance / micro-siting of infrastructure. This is considered to be an unlikely eventuality.

4. If necessary, further pre-construction or construction phase monitoring and mitigation of bedrock excavations by a professional palaeontologist and the Environmental Control Officer (ECO) / Environmental Site Officer (ESO), to be specified following the walkdown survey.

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

Given the potential for the exposure or recognition of additional, scientifically valuable fossil occurrences within the project footprints during the Construction Phase, a Chance Fossil Finds Protocol (as outlined below and tabulated in Appendix 5) must be included within the Environmental Management Programme (EMPr) for each respective grid connection project and fully implemented throughout the construction phase of the respective projects.

The ECO / ESO responsible for the Grid Connection developments must be made aware of the possibility of important fossil remains (vertebrate bones, teeth, burrows, petrified wood, plant-rich horizons *etc*.) being found or unearthed during the construction phase. 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 of the respective developments is therefore recommended. Significant fossil finds must 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).

A Work Plan approved by Heritage Western Cape (HWC) 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).

Table 5: Summary of proposed palaeontological heritage mitigation and monitoring actions for the JESSA Grid Connection projects

Mitigation actions	
The following measures are recommended:	• Cross-checking of final footprint against available palaeontological databases, satellite imagery by professional palaeontologist. • Pre-construction walkdown of potentially sensitive, unsurveyed sectors of footprint by professional palaeontologist. • Palaeontological recording and sampling / collection of valuable fossils threatened by development (<20 m from footprint). • Implementation of Chance Fossil Finds Protocol by ECO / ESO during Construction Phase with recording and collection of significant new finds by professional palaeontologist.
Monitoring	
The following monitoring is recommended:	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.

9. CONCLUSIONS AND SUMMARY

9.1 Summary of Findings

The combined JESSA Grid Connection project area is situated in the Great Karoo region near the town of Beaufort West and is underlain by potentially fossiliferous continental (fluvial / lacustrine) sediments of the Lower Beaufort Group (Karoo Supergroup) that are assigned to the uppermost Abrahamskraal Formation (Karelskraal Member) and lowermost Teekloof Formation (Poortjie Member). The contact zone between the Karelskraal and Poortjie Members is of particular geological and palaeontological interest because it records environmental and biotic changes on land associated with the catastrophic end Middle Permian Mass Extinct Event of *c*. 260 million years ago. The northern sector of the project area traverses the internationally recognised Type Area for the previously defined *Pristerognathus* Assemblage Zone, centred on dissected hilly terrain close to the border between Farm 432 (property affected by JESSA Z and JESSA S Grid Connection projects) and Farm 10/170 (property affected by JESSA Z, JESSA M and JESSA S Grid Connection projects).

A scatter of historical vertebrate fossil sites of Middle to Late Permian age have been reported within the combined JESSA Grid Connection project area in the scientific literature. A substantial number of additional fossil sites have been recorded over the course of several recent site visits to the combined JESSA WEF (assessed as part of separate standalone Palaeontological Heritage Report) and Grid Connection (assessed as part of this Palaeontological Heritage Report) project area (2020-2021) as well as during a previous palaeontological survey of part of Farm 10/170 by Almond (2014). While most of the fossils recorded here so far are of limited scientific or conservation value (*e.g.,* highly weathered, fragmentary post-cranial bones, common invertebrate trace fossils), several vertebrate specimens are of considerable research interest. These include, most notably, skull material of large-bodied dinocephalians, gorgonopsian and therocephalian carnivores, small and medium-sized dicynodonts and the well-preserved skull of a rare temnospondyl amphibian. Several of these key fossil specimens have subsequently been formally collected by the ESI (Wits University) and no further mitigation is therefore required in these particular cases. A range of Late Caenozoic superficial deposits (alluvium, colluvium, eluvial gravels, soils, spring deposits *etc*) overlying large portions of the Lower Beaufort Group bedrocks are generally of low palaeosensitivity. The only fossils recorded from the Late Caenozoic superficial deposits within the JESSA Grid Connection project area are locally dense assemblages of calcretized rhizoliths (plant root casts) and/or termite burrows within older alluvial deposits along major drainage lines such as the Gamka River; these trace fossils are of widespread occurrence in the Great Karoo and of low scientific or conservation value.

No palaeontological heritage "No-Go" areas have been identified within the grid connection corridors for the respective grid connection projects, while all remaining recorded sites can potentially be effectively mitigated by professional palaeontological recording and collection in the pre-construction phase, if they are threatened by the proposed JESSA Grid Connection development (*i.e.* located < 20 m from the final footprint).

A provisional VERY HIGH palaeosensitivity is assigned to the majority of the combined Jessa Grid Connection project area by the DFFE Screening Tool. **This rating is, however, *contested* here. Given the sparse distribution of scientifically valuable fossil sites within the combined JESSA Grid Connection project area (all corridors), the overall palaeosensitivity of the project area is revised to LOW**. However, the occurrence of additional, unrecorded sites of High sensitivity within the grid corridors for the respective grid connection projects cannot be excluded since palaeontological surveying of such a large area has necessarily been at reconnaissance level.

In terms of palaeontological heritage, the Construction Phase impact significance of each of the proposed JESSA Grid Connection projects (namely JESSA M, JESSA S and JESSA Z Grid Connection), including all the component infrastructure listed in the project descriptions (electrical pylons, access roads, switching stations, possible MTS expansion *etc.*), is assessed as MEDIUM (negative) without mitigation and VERY LOW (negative) following mitigation. It is noted that construction of access roads may have a greater impact on fossil heritage than pylon footings and other infrastructure. No significant further impacts are anticipated in the Operational and De-commissioning Phases. This assessment applies equally to the preferred and alternative grid connection network (as well as to each separate grid connection application, *viz*. JESSA M, JESSA S and JESSA Z grid connection projects), so there is no preference for one or other alternative on palaeontological heritage grounds.

The impact significance of the "No-Go" Alternative would probably, on balance, have a neutral impact on palaeontological heritage. This is applicable to all three (3) proposed JESSA Grid Connection projects. Anticipated cumulative impacts of the proposed JESSA WEF (namely JESSA Z, JESSA M and JESSA S WEF projects) and Grid Connection (namely JESSA Z, JESSA M and JESSA S Grid Connection projects) renewable energy projects in the context of several authorised WEF, solar and grid connection projects in the Beaufort West area are assessed as MEDIUM (negative) without mitigation, falling to LOW (negative) 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 JESSA Grid Connection projects (namely JESSA Z, JESSA M and JESSA S), including the possible MTS expansion, and there are no objections to their authorization**.

The final, authorised layouts of the respective JESSA Grid Connection projects (JESSA Z, JESSA M and JESSA S) must be cross-checked against the available fossil database and other relevant resources (*e.g.,* satellite imagery, geological maps) by the palaeontological specialist who must make recommendations for pre-construction phase mitigation, if any proves necessary (*N.B.* Most of the recorded fossil sites do not warrant mitigation). This might entail, for example, focussed palaeontological walk-downs of selected, previously unsurveyed and potentially sensitive sectors of the respective project footprints, with judicious sampling or collection of potentially threatened fossil material of scientific and/or conservation value. A Work Plan approved by Heritage Western Cape (HWC) will be required by the specialist palaeontologist responsible for mitigation work.

Given the potential for the exposure or recognition of additional, scientifically valuable fossil occurrences within the JESSA Grid Connection project footprints during the Construction Phase, a Chance Fossil Finds Protocol (as outlined below and tabulated in Appendix 6) 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 respective grid connection developments must be made aware of the possibility of important fossil remains (vertebrate bones, teeth, burrows, petrified wood, plant-rich horizons *etc*.) being found or unearthed during the construction phase of the respective developments. 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 of each respective grid connection development is therefore recommended. Significant fossil finds must be safeguarded and reported at the earliest opportunity to HWC 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).

9.2 Conclusions and Impact Statement

The combined JESSA Grid Connection project area near Beaufort West is situated in a subregion of the Main Karoo Basin of South Africa that has yielded important palaeontological data regarding the consequences and palaeo-environmental setting on land of the catastrophic end-Middle Permian Mass Extinction Event of ~260 million years ago. However, despite the provisional Very High palaeosensitivity assigned to almost the entire project area, 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. It is noted that the Grid Connection project area traverses the recognized Type Area of the *Pristerognathus* Assemblage Zone. Several of the scientifically important vertebrate fossils recently recorded here have already been collected and therefore do not require mitigation.

In terms of palaeontological heritage resources, each of the three JESSA Grid Connection developments is assigned an overall impact significance rating (Construction Phase) of MEDIUM (negative) without mitigation and VERY LOW (negative) following proposed mitigation. No significant further impacts on fossil heritage resources are anticipated in the planning, operational and decommissioning phases. This assessment applies equally to the preferred and alternative grid connection networks under consideration for the respective grid connection projects, so there is no preference for either option on palaeontological heritage grounds.

The "No-Go" Option will probably have a neutral impact. Anticipated cumulative impacts in the context of several authorized renewable energy projects in the Beaufort West region are assessed as MEDIUM (negative) significance without mitigation and LOW (negative) significance after mitigation.

The proposed JESSA grid connection developments are not fatally flawed. On condition that the recommended mitigation measures (including the Chance Fossil Finds Protocol) are included within the respective EMPrs and implemented in full during the construction phase, **there are no objections on palaeontological heritage grounds to the authorization of the respective JESSA Grid Connection projects**. A Work Plan approved by Heritage Western Cape (HWC) will be required by the specialist palaeontologist responsible for mitigation work.

10. ACKNOWLEDGMENTS

Ms Alice Moropa, Ms Liandra Scott-Shaw and Mr Stephan Jacobs of SLR Consulting are all thanked for commissioning this study, for providing the necessary project information, for careful editorial input and for ably facilitating the field study at short notice.

I am grateful to Ms Jenna Lavin of CTS Heritage, Cape Town, for discussions on heritage issues and assistance in the reporting phase.

The following palaeontological colleagues generously provided helpful input into the palaeontology of the Lower Beaufort Group in the Beaufort West Region: Professor Bruce Rubidge and Dr Marc Van den Brandt (Wits

University, Johannesberg), Dr Michael Day (Natural History Museum, London) and Dr Kenneth D. Angielczyk (Field Museum of Natural History, Chicago).

Mnr Appie Viviers and his wife Marietjie are heartily thanked for generous hospitality during our site visits as well as for directing us to important fossil sites.

Finally, the companionship in the field, substantial palaeontological contributions as well as logistical backup kindly provided by Ms Madelon Tusenius are all highly appreciated, as always.

11. REFERENCES

ALMOND, J.E. 2010a. Eskom Gamma-Omega 765kV transmission line: Phase 2 palaeontological impact assessment. Sector 1, Tanqua Karoo to Omega Substation (Western and Northern Cape Provinces), 95 pp + appendix. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010b. Palaeontological impact assessment: pre-scoping desktop study. Proposed Mainstream wind farm to the south of Beaufort West, Western Cape, 19 pp. Natura Viva cc., Cape Town.

ALMOND, J.E. 2010c. Areas proposed for low-cost housing, Beaufort West, Western Cape Province. Palaeontological impact assessment: combined desktop & scoping study, 19 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2011a. Proposed Photovoltaic Power Facility, Farm Steenrotsfontein 168, Beaufort West Municipality, Western Cape Province. Palaeontological impact assessment: desktop study, 23 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2011b. Proposed windfarm development, Beaufort West Municipality, Western Cape. Palaeontological specialist study: combined desktop & field-based assessment, 27 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2014. Proposed Droërivier Solar Facility, Portion 55 of Farm 168 Steenrotsfontein and a portion of Portion 10 of Farm 170 Weltevreden, Beaufort West Municipality, Western Cape. Palaeontological impact assessment: combined desktop & field-based study, 53 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2018. Proposed Trakas and Beaufort West 140 MW Wind Farms and associated electrical infrastructure near Beaufort West, Central Karoo District, Western Cape. Combined desktop and field-based study, 61 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2020a. Lombaardskraal Renewable Energy Facility project area, Beaufort West, Western Cape. Palaeontological heritage site sensitivity assessment: combined desktop & field-based study, 22 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2020b. Grid connection for the proposed Redcap Nuweveld Wind Farms, Beaufort West Local Municipality, Central Karoo District Municipality, Western Cape. Palaeontological heritage assessment: desktop and field-based report, 101 pp. Natura Viva cc Cape Town.

ALMOND, J.E. 2021a. Proposed Development of the Kwagga 1 Wind Energy Facility near Beaufort West in the Central Karoo District, Western Cape. Palaeontological heritage: combined desktop & field-based screening study & site sensitivity verification, 18 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2021b. Proposed Development of the Kwagga 2 Wind Energy Facility near Beaufort West in the Central Karoo District, Western Cape. Palaeontological heritage: combined desktop & field-based screening study & site sensitivity verification, 17 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2021c. Proposed Development of the Kwagga 3 Wind Energy Facility near Beaufort West in the Central Karoo District, Western Cape. Palaeontological heritage: combined desktop & field-based screening study & site sensitivity verification, 18 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2021d. Proposed construction of the Koup 1 Wind Energy Facility and associated grid infrastructure, near Beaufort West, Western Cape Province, South Africa. Palaeontological Heritage Report, 101 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2021d. Proposed construction of the Koup 2 Wind Energy Facility and associated grid infrastructure, near Beaufort West, Western Cape Province, South Africa. Palaeontological Heritage Report, 99 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2021f. Proposed development of the Bulskop PV cluster and associated grid connection, Beaufort West Local Municipality (Central Karoo District Municipality), Western Cape. Palaeontological heritage: combined desktop & field-based report, 41 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2021g. Proposed 33kV / 132 kV substation, 132 kV powerline and associated infrastructure for the authorised Beaufort West Cluster Wind Farms, Central Karoo District Municipality, Western Cape Province. Site sensitivity verification report, 22 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. & PETHER, J. 2008. Palaeontological heritage of the Western Cape. Interim SAHRA technical report, 20 pp. Natura Viva cc., Cape Town.

BAMFORD, M. 1999. Permo-Triassic fossil woods from the South African Karoo Basin. Palaeontologia africana 35, 25-40.

BAMFORD, M. 2021. Palaeontological Impact Assessment for the proposed Beaufort West Municipality Photo Voltaic Facility, Western Cape Province. Desktop Study (Phase 1) For ACO Associates, 20 pp.

BENDER, P.A. 2004. Late Permian actinopterygian (palaeoniscid) fishes from the Beaufort Group, South Africa: biostratigraphic and biogeographic implications. Council for Geoscience Bulletin 135, 84 pp.

BENDER, P.A. & BRINK, J.S. 1992. A preliminary report on new large mammal fossil finds from the Cornelia-Uitzoek site. South African Journal of Science 88: 512-515.

BLACKWELL, L., STEININGER, C., NEVELING, J. ABDALA, F., PEREIRA, L., MAYER, E., ROSSOUW, L., DE LA PEÑA P. & BRINK, J. 2017. Holocene large mammal mass death assemblage from South Africa. Quaternary International xxx (2017), p1-15.

BOONSTRA, L.D. 1969. The fauna of the *Tapinocephalus* Zone (Beaufort Beds of the Karoo). Annals of the South African Museum 56: 1-73.

BOUSMAN, C.B. *et al.* 1988. Palaeoenvironmental implications of Late Pleistocene and Holocene valley fills in Blydefontein Basin, Noupoort, C.P., South Africa. Palaeoecology of Africa 19: 43-67.

BRINK, J.S. 1987. The archaeozoology of Florisbad, Orange Free State. Memoirs van die Nasionale Museum 24, 151 pp.

BRINK, J.S. *et al.* 1995. A new find of *Megalotragus priscus* (Alcephalini, Bovidae) from the Central Karoo, South Africa. Palaeontologia africana 32: 17-22.

BRINK, J.S. & ROSSOUW, L. 2000. New trial excavations at the Cornelia-Uitzoek type locality. Navorsinge van die Nasionale Museum Bloemfontein 16, 141-156.

CARROLL, R. 2009. The Rise of Amphibians: 365 Million Years of Evolution. Johns Hopkins University Press, Baltimore, 360 pp.

CHURCHILL, S.E. et al. 2000. Erfkroon: a new Florisian fossil locality from fluvial contexts in the western Free State, South Africa. South African Journal of Science 96: 161-163.

COLE, D.I. & VORSTER, C.J. 1999. The metallogeny of the Sutherland area, 41 pp. Council for Geoscience, Pretoria.

COLE, D.I. AND WIPPLINGER, P.E. 2001, Sedimentology and molybdenum potential of the Beaufort Group in the main Karoo Basin, South Africa, Council for Geoscience Memoir, South Africa 80, 225 pp.

DAY, M.O. & RUBIDGE, B.S. 2010. Biostratigraphy of the *Tapinocephalus* Assemblage Zone (Beaufort Group, Karoo Supergroup), South Africa. South African Journal of Geology 123, 149-164.

DAY, M.O. AND RUBIDGE, B.S., 2014. A brief lithostratigraphic review of the Abrahamskraal and Koonap Formations of the Beaufort Group, South Africa: Towards a basin-wide stratigraphic scheme for the Middle Permian Karoo. Journal of African Earth Sciences 100, 227-242.

DAY, M.O., GUVEN, S., ABDALA, F., JIRAH, S., RUBIDGE, B.S. AND ALMOND, J. 2015a. Youngest dinocephalian fossils extend the Tapinocephalus Zone, Karoo Basin, South Africa. South African Journal of Science 111, 78-82.

DAY, M.O., RAMEZANI, J., BOWRING, S.A., SADLER, P.M., ERWIN, D.H., ABDALA, F. & RUBIDGE, B.S. 2015b. When and how did the terrestrial mid-Permian mass extinction occur? Evidence from the tetrapod record of the Karoo Basin, South Africa. Proc. R. Soc. B 282: 20150834. http://dx.doi.org/10.1098/rspb.2015.0834

DAY, M.O. & RUBIDGE, B.S.. 2020. Biostratigraphy of the *Tapinocephalus* Assemblage Zone (Beaufort Group, Karoo Supergroup), South Africa. South African Journal of Geology 123, 149 - 164.

DAY, M.O. & SMITH, R.M.S. 2020. Biostratigraphy of the *Endothiodon* Assemblage Zone (Beaufort Group, Karoo Supergroup), South Africa. South African Journal of Geology 123, 164 - 180.

DAY, M.O. & RUBIDGE, B.S. 2021. The Late Capitanian mass extinction of terrestrial vertebrates in the Karoo Basin of South Africa. Froniers in Earth Science 9, article 631198, 15 pp.

DE RUITER, D.J., BROPHY, J.K., LEWIS, P.J., KENNEDY, A.M., STIDHAM, T.A., CARLSON, K.B. & HANCOX, P.J. 2010. Preliminary investigation of Matjhabeng, a Pliocene fossil locality in the Free State of South Africa. Palaeontologia Africana 45, 11-22.

HERITAGE WESTERN CAPE 2016. Guide for minimum standards for archaeology and palaeontology reports submitted to Heritage Western Cape, 4 pp.

HERITAGE WESTERN CAPE 2021. Guide for minimum standards for archaeology and palaeontology reports submitted to Heritage Western Cape - June 2021, 6 pp.

JOHNSON, M.R. & KEYSER, A.W. 1979. The geology of the Beaufort West area. Explanation of geological Sheet 3222, 14 pp. Council for Geoscience, Pretoria.

JOHNSON, M.R., VAN VUUREN, C.J., VISSER, J.N.J., COLE, D.I., WICKENS, H. DE V., CHRISTIE, A.D.M., ROBERTS, D.L. & BRANDL, G. 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson. M.R., Anhaeusser, C.R. & Thomas, R.J. (eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Johannesburg & the Council for Geoscience, Pretoria.

KEYSER, A. W. 1966. Some indications of arid climate during the deposition of the Beaufort Series. Annals of the Geological Survey of South Africa 5,77–79.

KEYSER, A.W. & SMITH, R.M.H. 1977-78. Vertebrate biozonation of the Beaufort Group with special reference to the Western Karoo Basin. Annals of the Geological Survey of South Africa 12: 1-36.

KITCHING, J.W. 1977. The distribution of the Karroo vertebrate fauna, with special reference to certain genera and the bearing of this distribution on the zoning of the Beaufort beds. Memoirs of the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, No. 1, 133 pp (incl. 15 pls).

KLEIN, R.G. 1984. The large mammals of southern Africa: Late Pliocene to Recent. In: Klein, R.G. (Ed.) Southern African prehistory and paleoenvironments, pp 107-146. Balkema, Rotterdam.

MACRAE, C. 1999. Life etched in stone. Fossils of South Africa, 305 pp. The Geological Society of South Africa, Johannesburg.

MARCHETTI L. et al. 2019. Permian-Triassic vertebrate footprints from South Africa: Ichnotaxonomy, producers and biostratigraphy through two major faunal crises. Gondwana Research 72, 139-168.

McCARTHY, T. & RUBIDGE, B. 2005. The story of Earth and life: a southern African perspective on a 4.6-billion-year journey. 334pp. Struik, Cape Town.

MEADOWS, M.E. & WATKEYS, M.K. 1999. Palaeoenvironments. In: Dean, W.R.J. & Milton, S.J. (Eds.) The karoo. Ecological patterns and processes, pp. 27-41. Cambridge University Press, Cambridge.

NEUMANN, S. 2020. Taxonomic revision of the tapinocephalid dinocephalian subfamilies Moschopinae, Tapinocephalinae and Reibeeckosaurinae – the key to understanding Middle Permian tetrapod biodiversity. Unpublished PhD thesis, University of the Witwatersrand, Johannesburg, 408pp.

NICOLAS, M.V. 2007. Tetrapod diversity through the Permo-Triassic Beaufort Group (Karoo Supergroup) of South Africa. Unpublished PhD thesis, University of Witwatersrand, Johannesburg.

PAIVA, F., 2015. Fluvial facies architecture and provenance history of the Abrahamskraal-Teekloof Formation transition (Lower Beaufort Group) in the main Karoo Basin. Unpublished M.Sc. dissertation, University of Cape Town, Cape Town, 98pp.

PARTRIDGE, T.C. & MAUD, R.R. 1987. Geomorphic evolution of southern Africa since the Mesozoic. South African Journal of Geology 90: 179-208.

PARTRIDGE, T.C., BOTHA, G.A. & HADDON, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.

PARTRIDGE, T.C. & SCOTT, L. 2000. Lakes and pans. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.145-161. Oxford University Press, Oxford.

RETALLACK, G.J., METZGER, C.A., GREAVER, T., HOPE JAHREN, A., SMITH, R.M.H. & SHELDON, N.D. 2006. Middle – Late Permian mass extinction on land. GSA Bulletin 118, 1398-1411.

ROSSOUW, L. 2006. Florisian mammal fossils from erosional gullies along the Modder River at Mitasrust Farm, Central Free State, South Africa. Navorsinge van die Nasionale Museum Bloemfontein 22, 145-162.

SAHRA 2013. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.

SCOTT, L. 2000. Pollen. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.339-35. Oxford University Press, Oxford.

SKEAD, C.J. 1980. Historical mammal incidence in the Cape Province. Volume 1: The Western and Northern Cape, 903pp. Department of Nature and Environmental Conservation, Cape Town.

SMITH, R.M.H. & KEYSER, A.W. 1995a. Biostratigraphy of the *Tapinocephalus* Assemblage Zone. Pp. 8-12 in Rubidge, B.S. (ed.) Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Stratigraphy, Biostratigraphic Series No. 1. Council for Geoscience, Pretoria.

SMITH, R.M.H. & KEYSER, A.W. 1995b. Biostratigraphy of the *Pristerognathus* Assemblage Zone. Pp. 13-17 in Rubidge, B.S. (ed.) Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Stratigraphy, Biostratigraphic Series No. 1. Council for Geoscience, Pretoria.

SMITH, R., RUBIDGE, B. & VAN DER WALT, M. 2012. Therapsid biodiversity patterns and paleoenvironments of the Karoo Basin, South Africa. Chapter 2 pp. 30-62 in Chinsamy-Turan, A. (Ed.) Forerunners of mammals. Radiation, histology, biology. xv + 330 pp. Indiana University Press, Bloomington & Indianapolis.

SMITH, R.M.S. et al. 2020. Introduction to the tetrapod biozonation of the Karoo Supergroup. South African Journal of Geology 123, 131-140 • doi:10.25131/sajg.123.0009.

VAN DER WALT, J. 2019. Phase 2 Strategic Environmental Assessment for Wind and Solar Photovoltaic Energy Development in South Africa. Appendix A3. Heritage Scoping Assessment Report, 65 pp. CSIR.

JESSA GRID CONNECTION PIA - APPENDICES

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: JESSA WEF AND GRID CONNECTION PROJECT AREAS NEAR BEAUFORT WEST, WESTERN CAPE - FOSSIL SITE DATA (2014, 2020-2021)

All GPS readings were taken in the field using a hand-held Garmin GPSmap 64s instrument. The datum used is WGS 84. See Figures 64 to 66 for satellite maps showing the distribution of these fossil localities. Please note that:

- Locality data for South African fossil sites in *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 various field surveys. The absence of recorded fossil sites in any area therefore does *not* mean that no fossils are present there.
- Details of fossil sites recorded on Farm Weltevreden 10/170 are provided in the PIA report by Almond (2014).
- The detailed stratigraphic data for each site is provisional (largely based on the published CGS 1: 250 000 geology sheet) and has yet to be confirmed.

DROERIVIER SOLAR PIA 2014		
LOC	**South**	**Comments**
001	S32 27 52.3 E22 31 58.6	Farm Weltevreden 170/10. Small hill near S boundary of study area with well-exposed L Beaufort mudrocks, four small dicynodont skulls (*e.g., Diictodon*), possible carnivore coprolite and several small vertebrate burrows, gypsum pseudomorphs. Proposed Field Rating IIIB Local Resource. Specimen to be collected by palaeontological specialist if ≤ 20m from project footprint.
007	S32 27 24.3 E22 32 29.0	Farm Weltevreden 170/10. Upper Poortjie Member mudrocks. Small mudrock exposures of L Beaufort mudrocks along low escarpment. Isolated fossil postcranial limb bone fragments. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
008	S32 27 22.9 E22 32 26.9	Farm Weltevreden 170/10. Upper Poortjie Member mudrocks. Sun-cracked large fossil postcranial bone fragment. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
011	S32 27 20.3 E22 32 32.3	Farm Weltevreden 170/10. Upper Poortjie Member mudrocks. Fragments of tetrapod jaws in calcrete nodules of gorgonopsian with large tusk and large-bodied dicynodont *Endothiodon* (2 lower jaws). Proposed Field Rating IIIB Local Resource. Material collected by Wits University August 2021, so no mitigation required.
012	S32 27 20.5 E22 32 32.1	Farm Weltevreden 170/10. Upper Poortjie Member. Fragments of tetrapod jaws in calcrete nodules (probable gorgonopsian, large dicynodont *Endothiodon*)
017	S32 27 15.1 E22 31 58.1	Farm Weltevreden 170/10. Poortjie Member. Gentle hillslope and stream gulley exposures of Lower Beaufort mudrocks. Four small skulls (probably *Diiictodon, Pristerodon*), front limb (*ibid*.) preserved within calcrete nodules. Gypsum rose pseudomorphs. Proposed Field Rating IIIB Local Resource. Specimen to be collected by palaeontological specialist if ≤ 20m from project footprint.
019	S32 26 58.2 E22 31 51.3	Farm Weltevreden 170/10. Poortjie Member. Small dicynodont skull (probably *Diictodon*) embedded within mudrock, river bed exposure. Associated with abundant gypsum rose pseudomorphs. Palaeosurfaces with entrances to vertical burrows. Proposed Field Rating IIIB Local Resource. Specimen to be collected by palaeontological specialist if ≤ 20m from project footprint.
021	S32 26 57.2 E22 31 45.3	Farm Weltevreden 170/10. Well-preserved small dicynodont skull within pedocrete horizon (possibly *Pristerodon*). Proposed Field Rating IIIB Local Resource. Specimen to be collected by palaeontological specialist if ≤ 20m from project footprint.
022	S32 26 06.2 E22 31 53.5	Farm Weltevreden 170/10. Poortjie Member. Downwasted gravels of brown ferruginous carbonate concretions, rounded sandstone corestones with sparse weathered fragments of robust fossil bones. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
023	S32 25 53.2 E22 31 52.6	Farm Weltevreden 170/10. Poortjie Member. Extensive stream bed and hillslope mudrock exposures, downwasted gravels of brown ferruginous carbonate concretions, rounded sandstone corestones with sparse weathered fragments of robust fossil bones. Calcretised desiccation cracked mudrocks. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
030	S32 24 57.3 E22 32 21.8	Farm Weltevreden 170/10. Probably Poortjie Member. Streambed exposure of Lower Beaufort mudrocks, isolated bone fragments within siltstones, horizons of abundant vertical to horizontal invertebrate burrows (possibly *Scoyenia*), calcretised desiccation cracks. Proposed Field Rating IIIC Local Resource. No mitigation recommended.

033	S32 24 46.5 E22 32 18.4	Farm Weltevreden 170/10. Probably Poortjie Member. Extensive streambed exposure of Lower Beaufort Group bedrocks. Crevasse splay sandstones with palaeosurfaces showing wave rippled tops, washed-out burrows on soles, adhesion warts, small-scale invertebrate trace fossils on upper surfaces, possible reworked pebbles. Two small dicynodont skulls within calcrete nodules in underlying mudrocks. Proposed Field Rating IIIB Local Resource. Specimen to be collected by palaeontological specialist if ≤ 20m from project footprint.
JESSA WESTERN GRID ALTERNATIVE SOUTH AUGUST 2021		
211	32°29'14.22"S 22°32'14.92"E	Farm 432. Low exposures of Poortjie member purple-brown mudrocks. Thin ferruginous palaeocalcrete horizons with simple horizontal burrows (*c*. 5 mm wide). Proposed Field Rating IIIC Local Resource. No mitigation recommended.
213	32°28'46.87"S 22°32'23.28"E	Farm 432. Extensive low hillslope exposures of Poortjie Member. Channel breccias containing mudflake intraclasts and sparse, small, reworked bone fragments, rounded or angular shards. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
218	32°28'3.82"S 22°32'11.78"E	Farm 432. Thick mudrock package within middle to upper Poortjie Member. Probable intact temnospondyl amphibian skull *in situ*. Proposed Field Rating II. Specimen to be collected by Prof. Bruce Rubdige (Wits University) so no mitigation required.
219	32°28'2.10"S 22°32'8.71"E	Farm 432. Extensive low hillslope exposures of Poortjie Member. Calcretised concentrated bone hash with angular bone fragments / shards up to 2 cm across (mostly much smaller) as well as gypsum pseudomorphs. Possibly concentration of sun-cracked bone in floodplain hollow / pond, or even coprolitic in origin (but *not* obviously phosphatic). Proposed Field Rating IIIC Local Resource. No mitigation recommended.
220	32°28'3.37"S 22°32'4.13"E	Farm 432. Extensive low hillslope exposures of Poortjie Member. Sandstone float block containing disarticulated postcrania (ribs, limb bones) of small tetrapod. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
221	32°28'3.54"S 22°32'3.31"E	Farm 432. Extensive low hillslope exposures of Poortjie Member. Sandstone float block containing disarticulated postcrania (limb bones) of small tetrapod. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
JESSA WESTERN GRID ALTERNATIVE NORTH SEPT 2021		
368	32°25'57.55"S 22°31'54.27"E	Farm Weltevreden 170/10. Upper Abrahamskraal Formation or Poortjie Member. Extensive field of rusty-brown pedogenic concretions with occasional, suncracked bone inside. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
369	32°25'57.61"S 22°31'52.98"E	Farm Weltevreden 170/10. Upper Abrahamskraal Formation or Poortjie Member. Two fragments of robust rolled bone (possibly dinocephalian or pareiasaur) in surface float. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
370	32°25'53.35"S 22°31'54.75"E	Farm Weltevreden 170/10. Area of extensive Poortjie Member mudrock exposure. Small dicynodont skull with broad intertemporal region. Proposed Field Rating IIIB Local Resource. Specimen to be collected by palaeontological specialist if ≤ 20m from project footprint.
371	32°25'53.27"S 22°31'56.15"E	Farm Weltevreden 170/10. Poortjie Member. Rib cage of small tetrapod (probably therapsid) within grey-green siltstone. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
372	32°25'53.07"S 22°31'58.27"E	Farm Weltevreden 170/10. Upper Abrahamskraal Formation or lower Poortjie Member. Several fragments of robust, suncracked / weathered bone (possibly dinocephalian or pareiasaur) in surface float. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
373	32°25'53.43"S 22°32'0.13"E	Farm Weltevreden 170/10. Poortjie Member. Small dicynodont skull with artioculated lower jaw. Proposed Field Rating IIIB Local Resource. Specimen to be collected by palaeontological specialist if ≤ 10m from project footprint.
376	32°26'27.27"S 22°31'56.09"E	Farm Weltevreden 170/10. Poortjie Member. Small, poorly-preserved dicynodont skull within pedocrete concretion. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
377	32°26'27.01"S 22°31'55.73"E	Farm Weltevreden 170/10. Poortjie Member. Small. poorly-preserved bones within pedocrete concretion. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
378	32°26'27.34"S 22°31'54.66"E	Farm Weltevreden 170/10. Poortjie Member. Several partial skulls and other skeletal material of small tetrapods preserved within pedocrete concretions. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
379	32°26'27.19"S 22°31'54.53"E	Farm Weltevreden 170/10. Poortjie Member. Two partial skulls of small tetrapods preserved within pedocrete concretions. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
380	32°26'27.28"S 22°31'56.23"E	Farm Weltevreden 170/10. Poortjie Member. Partial small skull with well-developed canine tusks (probably *Diictodon*) preserved within pedocrete concretion. Proposed Field Rating IIIB Local Resource. Specimen to be collected by palaeontological specialist if ≤ 10m from project footprint.
383	32°27'9.86"S 22°32'1.10"E	Farm Weltevreden 170/10. Poortjie Member. Skull of small dicynodont with articulated lower jaw largely enclosed within pedocrete concretion. Proposed Field Rating IIIB Local Resource. Specimen to be collected by palaeontological specialist if ≤ 10m from project footprint.

385	32°27'15.12"S 22°31'58.09"E	Farm Weltevreden 170/10. Poortjie Member. Good, gentle gullied exposures of grey-green mudrocks with several small dicynodont skulls, some postcrania within pedocrete concretions. Proposed Field Rating IIIB Local Resource. Specimen to be collected by palaeontological specialist if ≤ 10m from project footprint.
387	32°27'52.21"S 22°31'57.61"E	Farm Weltevreden 170/10. Poortjie Member. Good, gentle gullied exposures of grey-green mudrocks with several small dicynodont skulls, some postcrania within pedocrete concretions. Some skulls with broad intertemporal region. Proposed Field Rating IIIB Local Resource. Specimen to be collected by palaeontological specialist if ≤ 10m from project footprint.
JESSA EASTERN GRID ALTERNATIVE & MTS EXPANSION AREA Oct 2021		
738	32°24'57.43"S 22°32'21.96"E	Farm Weltevreden 170/10. Poortjie Member. Mottled purple-brown mudrocks in stream bed with reedy plant stem casts (1-1.5 cm diam.), possible invertebrate burrows. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
740	32°24'46.33"S 22°32'18.21"E	Farm Weltevreden 170/10. Poortjie Member. Stream bed exposure of bioturbated wacke bed top with poorly-preserved horizontal invertebrate burrows. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
741	32°24'41.75"S 22°32'16.62"E	Farm Weltevreden 170/10. Poortjie Member. Stream bed exposure of wave-rippled palaeosurfaces on top of thin crevasse-splay sandstones with sandy mud-crack infills, invertebrate bioturbation, casts of reedy plant stems.
742	32°24'37.58"S 22°32'15.30"E	Farm Weltevreden 170/10. Poortjie Member. Stream bank exposure of mottled, crumbly purple-brown and grey-green mudrocks, thin distal crevasse splay sandstones containing a poorly preserved small, gently curved tetrapod burrow cast (*c*. 15 cm across). Proposed Field Rating IIIC Local Resource. No mitigation recommended.
743	32°24'37.39"S 22°32'15.22"E	Farm Weltevreden 170/10. Poortjie Member. Stream bank exposure of mottled, crumbly purple-brown and grey-green mudrocks, thin distal crevasse splay sandstones containing several poorly preserved, straight, inclined to subhorizontal tetrapod burrow casts (*c*. 15-30 cm across), one with possible scratch marks on ventrolateral wall. Mudrocks contain dispersed pedocrete concretions, some with skeletal (cranial and postcranial) remains of small dicynodonts. Proposed Field Rating IIIB Local Resource. Specimens to be sampled by palaeontological specialist if ≤ 10m from project footprint.
754	32°25'33.64"S 22°32'31.51"E	Farm Weltevreden 170/10. Thick (sev. meters) sandy alluvium along southern bank of Gamka River; Older alluvium extensively calcretised with dense subvertical rhizoliths, possibly also invertebrate burrows (*e.g.,* of termites). Proposed Field Rating IIIC Local Resource. No mitigation recommended.
760	32°25'26.44"S 22°31'49.93"E	Farm Weltevreden 170/10. Probable uppermost Abrahamskraal Formation (Karelskraal Member). Two fragments of robust rolled bone among surface gravels of pedocrete concretions. Proposed Field Rating IIIC Local Resource. No mitigation recommended.
766	32°30'0.40"S 22°33'28.67"E	Farm 432. Poortie Member mudrocks in bed of Lombaardskraal se Loop with poorly-preserved, gently inclined, straight tetrapod burrow (*c*. 15 cm wide). Proposed Field Rating IIIC Local Resource. No mitigation recommended.
767	32°29'59.01"S 22°33'31.71"E	Farm 432. Poortie Member mudrocks in bed of Lombaardskraal se Loop with poorly-preserved, gently inclined, straight tetrapod burrow (*c*. 15 cm wide). Proposed Field Rating IIIC Local Resource. No mitigation recommended.
775 (= 218)	32°28'3.72"S 22°32'11.86"E	Farm 432. Thick mudrock package within middle to upper Poortjie Member. Probable intact temnospondyl amphibian skull *in situ*. Proposed Field Rating II. Specimen to be collected by Prof. Bruce Rubdige (Wits University) so no mitigation required.

Loc.	**GPS data**	**Comments**
JESSA WEF TRIP 1 JULY 2020		
258	S32° 31' 58.3" E22° 29' 07.4"	Farm 6/319. Partial juvenile human skeleton (including skull, backbone) embedded in riverbank exposure of *c*. 2-3m-thick Late Caenozoic (probably Holocene) greyish, massive silty alluvium with sparse gravels. Possible flood victim within inundite deposit. Specimen subsequently lost due to bank collapse in recent flood, so no mitigation required.
259	S32° 33' 07.2" E22° 28' 40.2"	Farm 6/ 319. Upper Abrahamskraal Formation. Tapinocephalid dinocephalian postcrania (including backbone) as well as partial skull roof embedded within or weathering-out of thin (< 40 cm), yellowish, friable channel sandstone. Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if situated close to project footprint.
269	S32° 31' 52.0" E22° 27' 05.2"	Farm RE/319. Upper Abrahamskraal Formation. Highly weathered, fragmentary bones of large tetrapod within pedocrete nodules. Proposed Field Rating IIIC Local Resource. No mitigation required.
271	S32° 32' 07.3" E22° 26' 22.5"	Farm RE/319. Upper Abrahamskraal Formation. Bone fragments – possibly large rib - within float blocks of sandstone. Proposed Field Rating IIIC Local Resource. No mitigation required.

276	S32° 31' 21.0" E22° 24' 58.0"	Farm RE/319. Upper Abrahamskraal Formation. Weathered, ferruginised fragment of robust bone in float. Proposed Field Rating IIIC Local Resource. No mitigation required.
277	S32° 31' 21.0" E22° 24' 58.5"	Farm RE/319. Upper Abrahamskraal Formation. Numerous fragments of poorly-preserved, sun-cracked postcranial bones of a large-bodied tetrapod (pareiasaur or dinocephalian) in surface float. Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if situated close to project footprint.
280	S32° 32' 59.5" E22° 34' 06.6"	Farm RE/330. Lower Poortjie Member. Clump of weathered, fragmentary postcranial bones of a large-bodied tetrapod (pareiasaur or dinocephalian) in surface float. Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if situated close to project footprint.
281	S32° 33' 13.4" E22° 34' 15.8"	Farm RE/330. Lower Poortjie Member. Vertebrae and other postcranial remains of large-bodied tetrapod within ferruginous carbonate concretions. Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if situated close to project footprint.
282	S32° 33' 14.0" E22° 34' 12.4"	Farm RE/330. Lower Poortjie Member. Weathered postcranial remains, including ribs, of large-bodied tetrapod in float. Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if situated close to project footprint.
283	S32° 33' 13.7" E22° 34' 12.9"	Farm RE/330. Lower Poortjie Member. Weathered postcranial remains, including ribs, of large-bodied tetrapod in float. Proposed Field Rating IIIB Local Resource.Material to be sampled in pre-construction phase if situated close to project footprint.
285	S32° 33' 12.9" E22° 34' 12.4"	Farm RE/330. Lower Poortjie Member. *Possible* weathered fragment of thick dinocephalian skull roof (*possibly* with pineal foramen) in float. Proposed Field Rating IIIB Local Resource.Material to be sampled in pre-construction phase if situated close to project footprint.
286	S32° 33' 12.6" E22° 34' 13.3"	Farm RE/330. Lower Poortjie Member. Large vertebra and (?) rib of large-bodied tetrapod in float. Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if situated close to project footprint.
287	S32° 33' 12.4" E22° 34' 13.6"	Farm RE/330. Base of mudrock package within lower Poortjie Member. Extensive (*c*. 30 m along strike), voluminous scatter of postcranial bones (limbs, girdles, vertebrae, ribs *etc*) and fragmemtary skull material of tapinocephalid dinocephalians (> one individual, possibly *Styracocephalus* or *Criocephalosaurus*) at surface. Material possibly weathering-out from sandstone just upslope from site since external mould preservation of some bones within sandstone float blocks also seen here. Wide surface scatter of bones down slope, Proposed Field Rating IIIA Local Resource of high scientific interest. Site sampled by Wits University in March 2021. Material to be sampled and recorded further in pre-construction phase if situated close (≤ 20 m) to project footprint.
288	S32° 33' 12.4" E22° 34' 14.4"	Farm RE/330. Base of mudrock package within lower Poortjie Member. Eastern extension of dinocephalian fossil site outlined above, including probable skull material. Proposed Field Rating IIIA Local Resource of high scientific interest. Site sampled by Wits University in March 2021. Material to be sampled and recorded further in pre-construction phase if situated close (≤ 20 m) to project footprint.
290	S32° 33' 35.9" E22° 33' 10.2"	Farm RE/330. Poortjie Member. Numerous scattered blocks of reddish-brown to black, poorly-preserved, ferruginised petrified / silicified wood, possibly partially decomposed at time of diagenetic mineralisation. A few blocks are greyish with better preserved woody tissue. Blocks have probably weathered-out from yellowish-weathering channel sandstone slightly higher in succession. Proposed Field Rating IIIB Local Resource. Material to be sampled and recorded further in pre-construction phase if situated close (≤ 20 m) to project footprint.
291	S32° 33' 36.6" E22° 33' 11.6"	
292	S32° 33' 36.6" E22° 33' 12.1"	
293	S32° 33' 37.1" E22° 33' 12.3"	
294	S32° 33' 36.7" E22° 33' 13.0"	
295	S32° 33' 36.2" E22° 33' 12.9"	
297	S32° 32' 49.8" E22° 33' 15.4"	Farm RE/330. Poortjie Member. *In situ* small therocephalian skull. Specimen collected by Wits University March 2021. No mitigation necessary.
298	S32° 32' 47.7" E22° 33' 16.0"	Farm RE/330. Poortjie Member. Horizon of large ferruginous carbonate concretions containing highly-weathered, fragmentary remains of a large tetrapod (dinocephalian or pareiasaur). Proposed Field Rating IIIC Local Resource. No mitigation necessary.
300	S32° 32' 48.6" E22° 33' 19.7"	Farm RE/330. Poortjie Member. Fragmentary small bones within Fe-carbonate concretion in float. Proposed Field Rating IIIC Local Resource. No mitigation necessary.
309	S32° 30' 14.0" E22° 31' 08.6"	Farm 432. Upper Abrahamskraal Formation. Poorly-preserved fragmentary postcranial bone of large tetrapod in float. Proposed Field Rating IIIC Local Resource. No mitigation necessary.
310	S32° 30' 13.8" E22° 31' 08.6"	Farm 432. Upper Abrahamskraal Formation. End of long bone, vertebrae *etc* of large tetrapod (dinocephalian or pareiasaur) in float, associated with pedogenic calcrete nodule horizon.

		Proposed Field Rating IIIB Local Resource. Material to be sampled and recorded further in pre-construction phase if situated close (≤ 20 m) to project footprint.
311	S32° 30' 13.8" E22° 31' 08.9"	Farm 432. Upper Abrahamskraal Formation. Shoulder blade of large tetrapod (dinocephalian or pareiasaur) in float, associated with pedogenic calcrete nodule horizon. Material to be sampled and recorded further in pre-construction phase if situated close (≤ 20 m) to project footprint.
313	S32° 29' 58.9" E22° 31' 51.0"	Farm 432. Upper Abrahamskraal Formation. Tapinocephalid dinocephalian remains including skull material. Proposed Field Rating IIIB Local Resource. Specimen to be collected in pre-construction phase if threatened by development (< 20 m from project final footprint).
314	S32° 29' 59.0" E22° 31' 51.2"	Farm 432. Uppermost Abrahamskraal Formation. Probable upper Karelskraal Member. Cluster of partially buried, ferruginised bones of a dinocephalian (thick-skulled tapinocephalid). Proposed Field Rating IIIB Local Resource. Specimen to be collected in pre-construction phase if threatened by development (< 20m from project final footprint).
315	S32° 29' 58.9" E22° 31' 51.3"	As above – probably another individual of tapinocephalid dinocephalian with thick-roofed skull. Proposed Field Rating IIIB Local Resource. Specimen to be collected in pre-construction phase if threatened by development (< 20m from project final footprint).
316	S32° 29' 58.0" E22° 31' 51.7"	Farm 432. Upper Abrahamskraal Formation. Float block of sandstone with reedy plant stem casts or small invertebrate burrows. Proposed Field Rating IIIC Local Resource. No mitigation necessary.
320	S32° 30' 14.7" E22° 31' 37.0"	Farm 432. Riverbed and bank exposure of grey siltstones and wackes. Bedding planes with microbial mat textures, bioturbation, *possible* vertebrate burrow casts with smooth, bioturbated floors. Proposed Field Rating IIIC Local Resource. No mitigation necessary.
322	S32° 30' 45.7" E22° 31' 28.0"	Farm 432. Upper Abrahamskraal Formation. Possible sandstone small vertebrate burrow cast embedded within hackly grey mudrocks. Proposed Field Rating IIIC Local Resource. No mitigation necessary.
335	S32° 31' 31.3" E22° 29' 16.2"	Farm 6/139. Upper Abrahamskraal Formation. Partial skull of small dicynodont in float. Proposed Field Rating IIIB Local Resource. Specimen to be collected in pre-construction phase if threatened by development (< 20 m from project final footprint).
340	S32° 32' 17.6" E22° 28' 59.5"	Farm 6/319. Upper Abrahamskraal Formation. Weathered bone fragment within surface float. Proposed Field Rating IIIC Local Resource. No mitigation necessary.
341	S32° 32' 16.6" E22° 28' 57.9"	Farm 6/319. Upper Abrahamskraal Formation. Several fragmentary weathered bones within surface float. Proposed Field Rating IIIC Local Resource. No mitigation necessary.
342	S32° 33' 16.7" E22° 28' 47.8"	Farm 6/319. Upper Abrahamskraal Formation. Sun-cracked bone shards within ferruginous concretion. Proposed Field Rating IIIC Local Resource. No mitigation necessary.
343	S32° 33' 15.4" E22° 28' 50.1"	Farm 6/319. Upper Abrahamskraal Formation. Delicate postcrania (ribs, backbone) of small tetrapod preserved as moulds within sandstone float block. Proposed Field Rating IIIC Local Resource. No mitigation necessary.
345	S32° 33' 23.6" E22° 28' 39.5"	Farm 6/319. Upper Abrahamskraal Formation. Small therapsid skull, toothed with broad skull table within nodule in float – possibly a small predator. Proposed Field Rating IIIB Local Resource. Specimen to be collected in pre-construction phase if threatened by development (< 20 m from project final footprint).
346	S32° 33' 23.3" E22° 28' 38.6"	Farm 6/319. Upper Abrahamskraal Formation. Small dicynodont skull embedded within bedrock. Proposed Field Rating IIIB Local Resource. Specimen to be collected in pre-construction phase if threatened by development (< 20 m from project final footprint).
350	S32° 33' 14.4" E22° 29' 17.4"	Farm 6/319. Upper Abrahamskraal Formation. Several robust bone fragments in surface float. Proposed Field Rating IIIB Local Resource. Specimen to be collected in pre-construction phase if threatened by development (< 20 m from project final footprint).
355	S32° 32' 25.1" E22° 31' 52.4"	Farm 5/319. Uppermost Abrahamskraal Formation. Small, largely complete therocephalian skull and partial postcrania preserved within pale brownish sandstone or ferruginous calcrete. Material collected by Wits University in March 2021 so no mitigation necessary.
359	S32° 31' 32.5" E22° 31' 40.8"	Farm 5/319. Upper Abrahamskraal Member. Undulating upper bedding surface of grey-green sandstone showing intense bioturbation by dense assemblages of cylindrical, horizontal to oblique invertebrate burrows (*c*. 5 mm across), infilled with sandstone or preserved as hollow moulds. Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if threatened by development (< 20 m from project final footprint).
360	S32° 31' 31.8" E22° 31' 41.5"	Farm 5/319. Upper Abrahamskraal Member. Dense assemblages of invertebrate burrows, as above, traces mainly preserved as hollow moulds. Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if threatened by development (< 20 m from project final footprint).
369	S32° 29' 53.5" E22° 30' 04.7"	Farm 1/ 319. Uppermost Karelskraal Member or lower Poortjie Member. Partially weathered but largely intact, rounded dinocephalian skull within concretion - probably *Criocephalosaurus*. High scientific value. Specimen collected by Wits University March 2021. No mitigation necessary.

381	S32° 29' 37.7" E22° 27' 49.7"	Farm 7/319. Upper Abrahamskraal Formation. Several blocks of robust tetrapod bones dispersed within surface gravels. Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if threatened by development (< 20 m from project final footprint).
383	S32° 30' 08.2" E22° 27' 49.3"	Farm 1/ 319. Upper Abrahamskraal Formation. Float blocks of wave-ripple sandstone with small horizontal invertebrate trace fossils on bed tops. Proposed Field Rating IIIC Local Resource. No mitigation necessary.
JESSA WITS UNIVERSITY VISIT MARCH 2021		
151 a	S32° 32' 52.6" E22° 34' 07.7"	Farm RE/330. Poortjie Member. *In situ* poorly-preserved skull of small dicynodont, probably *Diictodon*. Proposed Field Rating IIIB Local Resource. Specimen to be collected in pre-construction phase if threatened by development (<20 m from project final footprint).
154 a	S32° 32' 48.6" E22° 33' 20.0"	Farm RE/330. Poortjie Member. Fairly intact skull of small gorgonopsian (*cf Eriphostoma*) as well as postcranial remains preserved within reddish-brown sandstone and also collected from float. High scientific value. Specimen collected by Wits University March 2021. No mitigation necessary.
JESSA WEF & GRID TRIP 2 AUGUST 2021		
102	32°32'11.57"S 22°28'5.99"E	Small float block of yellowish sandstone – possibly from the Poortie Member - with poorly-preserved horizontal burrows (*c*. 1 cm diameter). Proposed Field Rating IIIC Local Resource. No mitigation required.
104	32°32'0.20"S 22°26'38.24"E	Upper Abrahamskraal Fm. Small palaeocalcrete concretion in float containing rolled, weathered bone fragment. Proposed Field Rating IIIC Local Resource. No mitigation required.
106	32°31'57.68"S 22°25'16.38"E	Upper Abrahamskraal Fm. Possible but *equivocal*, straight to branching or intersecting sandstone burrow casts within crumbly mudrock matrix. Proposed Field Rating IIIC Local Resource. No mitigation required.
108	32°32'0.82"S 22°24'59.54"E	Upper Abrahamskraal Fm. Highly-jointed brownish-weathering wacke containing skull of a small dicynodont (narrow skull table – probably *Diictodon*). Proposed Field Rating IIIB Local Resource. Specimen to be collected in pre-construction phase if threatened by development (<20 m from project final footprint).
114	32°31'37.25"S 22°26'53.76"E	Upper Abrahamskraal Fm. Cylindrical, vertical sandstone cast of a lungfish burrow (*c*. 5 cm across) within crumbly grey silty mudrocks. Proposed Field Rating IIIC Local Resource. No mitigation required.
120	32°31'19.70"S 22°30'31.65"E	Upper Abrahamskraal Fm. Poorly-preserved compressions of equisetalean fern stems within siltstone matrix. Proposed Field Rating IIIC Local Resource. No mitigation required.
136	32°32'17.73"S 22°30'27.25"E	Farm 6/319. Upper Abrahamskraal Fm. Isolated, weathered robust limb bone in float (c. 10 cm long). Proposed Field Rating IIIB Local Resource. No mitigation required.
137	32°32'14.71"S 22°30'28.51"E	Farm 6/319. Upper Abrahamskraal Fm. Small bone (possibly part of skull) within pedocrete concretion plus isolated bone fragment in float. Proposed Field Rating IIIC Local Resource. No mitigation required.
144	32°33'7.01"S 22°29'43.67"E	Farm 6/319. Upper Abrahamskraal Fm. Several fragments of unidentifiable, weathered robust bone in float – probably weathered-out of flaggy sandstone in the area. Proposed Field Rating IIIB Local Resource. No mitigation required.
145	32°33'6.88"S 22°29'44.07"E	Farm 6/319. Upper Abrahamskraal Fm. Ferruginised sandstone in situ containing postcranial bones. Proposed Field Rating IIIB Local Resource. No mitigation required.
150	32°32'18.42"S 22°28'57.84"E	Farm 6/319. Upper Abrahamskraal Fm. Sandstone palaeosurface in farm track with adhesion warts (or microbial mat textures). Proposed Field Rating IIIC Local Resource. No mitigation required.
153	32°33'12.59"S 22°34'13.59"E	MAIN CRIOCEPHALOSAURUS SITE revisited (See Loc. 287 above).
161	32°33'16.82"S 22°34'12.19"E	Farm RE/330. Lower Poortjie Member. Isolated, weathered fragment of large limb bone (dinocephalian / pareiasaur) in float. Proposed Field Rating IIIB Local Resource. No mitigation required.
162	32°33'1.17"S 22°34'4.31"E	Farm RE/330. Lower Poortjie Member. Two weathered fragments of large limb bone (dinocephalian / pareiasaur) in float. Proposed Field Rating IIIB Local Resource. No mitigation required.
165	32°32'40.07"S 22°32'28.29"E	Farm RE/330. Lower Poortjie Member. Small rounded fragment of rolled bone in float. Proposed Field Rating IIIC Local Resource. No mitigation required.
170	32°31'47.00"S 22°32'48.95"E to 32°31'47.59"S 22°32'50.22"E	Farm RE/330. Lower Poortjie Member. Extensive exposures of thin-bedded, grey siltstone bedding surfaces running across modern river bed. Palaeosurfaces with microbial mat dimpled textures, possible falling water marks and abundant, cross-cutting, horizontal invertebrate burrows (possibly meniscate back-filled). Proposed Field Rating IIIB Local Resource. Locality protected by standard ecological buffer along drainage lines. No mitigation required.
174	32°31'48.90"S 22°32'46.25"E	Farm RE/330. Lower Poortjie Member. Riverbank exposure of grey mudrocks with isolated sinuous horizontal invertebrate intrastratal burrow (c. 2 cm wide) preserved in full relief with

		shallow dorsal furrow. Proposed Field Rating IIIC Local Resource. Locality protected by standard ecological buffer along drainage lines. No mitigation required.
176	32°31'50.15"S 22°32'44.75"E	Farm RE/330. Lower Poortjie Member. Undulose sandstone megarippled surface with dense bioturbation by invertebrate burrows (possibly meniscate back-filled) as well as enigmatic double furrows (*c.* 10 cm across). Proposed Field Rating IIIB Local Resource. Locality to be protected within 30 m buffer if situated close to project footprint.
181	32°30'1.26"S 22°30'9.81"E	Farm 1/319. Lower Poortjie Member. Two small blocks of weathered robust bone in float. Proposed Field Rating IIIC Local Resource. No mitigation required.
187	32°28'12.81"S 22°28'8.26"E	Farm 7/319. Lower Poortjie Member or uppermost Abrahamskraal Fm. Poorly-preserved, fragmentary postcrania of large tetrapod (pareiasaur or dinocephalian) preserved within several brown-weathering ferruginous carbonate pedocrete concretions. Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if situated close to (≤ 20 m) of project footprint.
191	32°28'18.95"S 22°28'22.70"E	Farm 7/319. Uppermost Abrahamskraal Fm pedocrete horizon with several fragments of robust tetrapod (pareiasaur or dinocephalian). Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if situated close to (≤ 20 m) of project footprint.
198	32°30'36.81"S 22°27'42.52"E	Farm 1/319. Uppermost Abrahamskraal Fm. *In situ*, partially ferruginised postcranial remains (vertebrae, ribs *etc*) of large tetrapod (pareiasaur or dinocephalian) with weathered out material in float downslope. Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if situated close to (≤ 20 m) of project footprint.
201	32°30'35.76"S 22°28'34.49"E	Farm 1/319. Uppermost Abrahamskraal Fm. Fragments of unidentifiable weathered bone in float. Proposed Field Rating IIIC Local Resource. No mitigation required.
202	32°30'34.39"S 22°28'35.97"E	Farm 1/319. Uppermost Abrahamskraal Fm. Scatter of numerous fragmentary remains of small-bodied carnivore in surface float. Proposed Field Rating IIIB Local Resource. Material to be sampled in pre-construction phase if situated close to (≤ 20 m) of project footprint.

APPENDIX 3: PALAEONTOLOGICAL HERITAGE SITE SENSITIVITY VERIFICATION: JESSA GRID CONNECTION PROJECTS, BEAUFORT WEST, WESTERN CAPE PROVINCE

SUMMARY

The provisional Very High Palaeosensitivity inferred by the DFFE screening tool for the three JESSA Grid Connection project areas near Beaufort West is *contested* here. Based on desktop analysis as well as a several site visits to the combined grid connection 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. The Low Palaeosensitivity inferred by the DFFE Screening Tool for alluvial deposits associated with the Gamka River drainage network is provisionally supported.

1.INTRODUCTION

ENERTRAG South Africa (Pty) Ltd is proposing to construct three (3) adjoining wind energy facilities (WEFs) *plus* three associated grid connection projects - together known as the JESSA Projects – on a site near Beaufort West in the Western Cape Province of South Africa (Figs. A3.1 to A3.3). The present combined desktop and field-based Site Sensitivity Verification Report covers the three JESSA Grid Connection project areas (namely JESSA M, JESSA S and JESSA Z Grid Connection projects), which include 132kV overhead powerlines, one switching station *per* WEF, access roads and a possible expansion of the existing Droërivier Main Transmission Substation (MTS), situated *c*. 8 km southwest of Beaufort West, where the power generated by the proposed JESSA WEFs will be fed into the National Grid. Even though these projects contribute to three separate applications, they will be considered in the same specialist site sensitivity verification report, given their very similar geological and palaeontological heritage character.

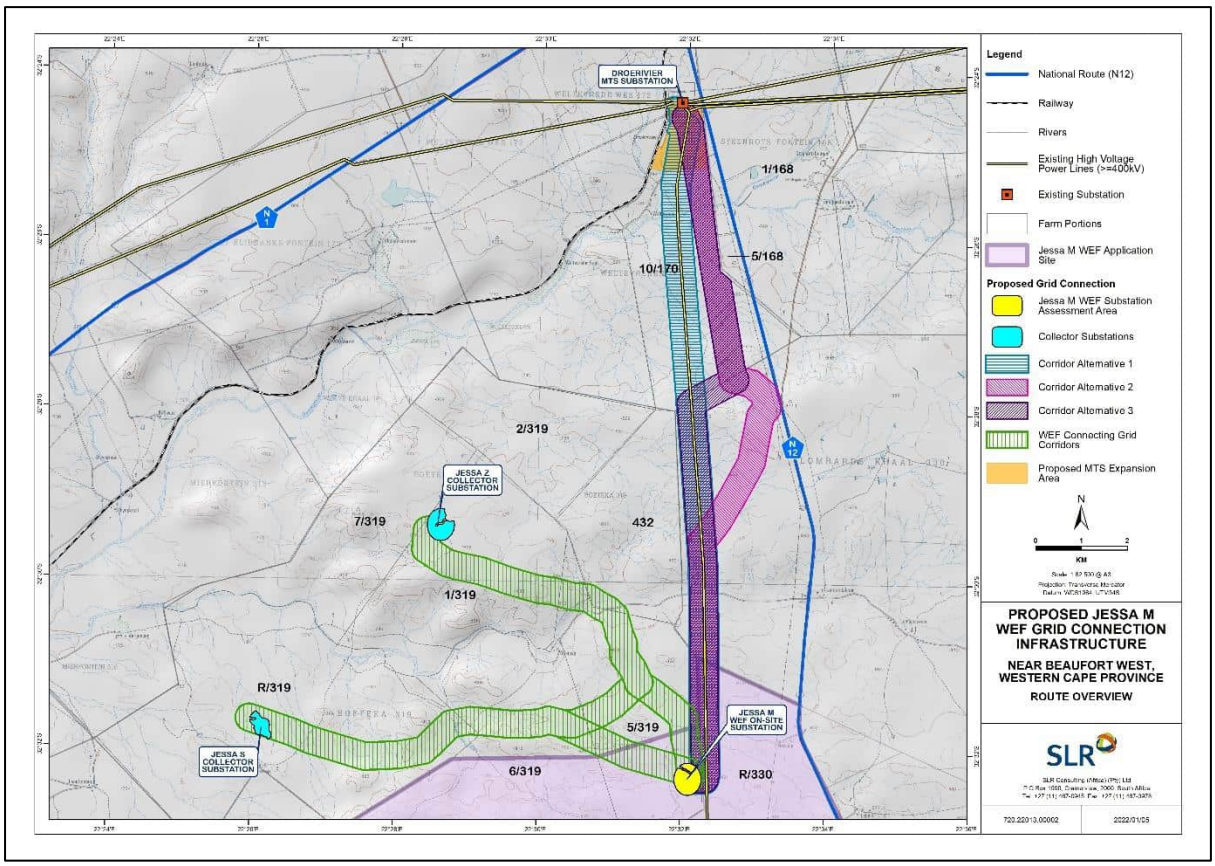

Figure A3.1: Locality Map of the Proposed JESSA M Grid Connection Corridors also showing the associated JESSA M WEF, situated near Beaufort West, Western Cape Province.

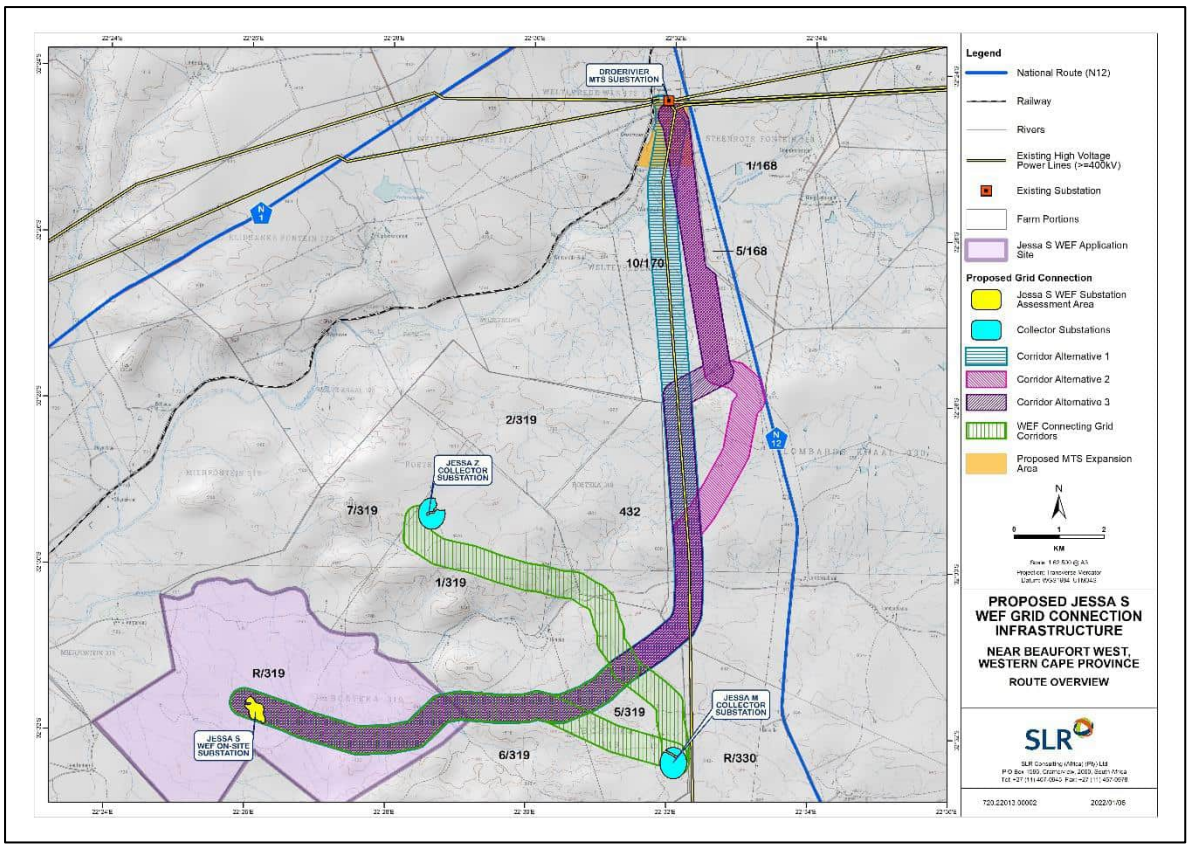

Figure A3.2: Locality Map of the Proposed JESSA S Grid Connection Corridors also showing the associated JESSA S WEF, situated near Beaufort West, Western Cape Province.

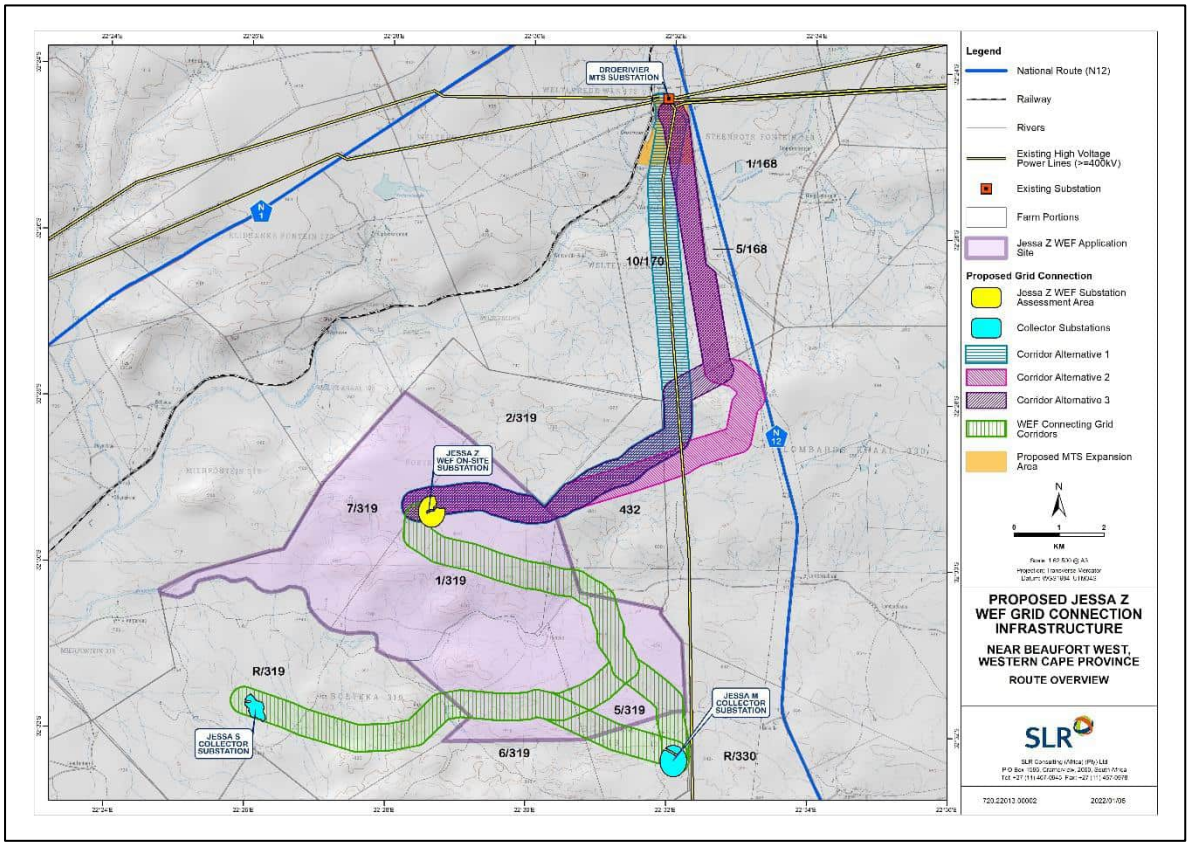

Figure A3.3: Locality Map of the Proposed JESSA Z Grid Connection Corridors also showing the associated JESSA Z WEF, situated near Beaufort West, Western Cape Province.

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 developments 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 JESSA Grid Connection project sites under these specialist protocols.

2.SITE SENSITIVITY VERIFICATION METHODOLOGY

The present palaeontological site sensitivity verification is based on:

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 (3222AD Klipbank, 3222BC Beaufort West, 3222CB Letjiesbos & 3222DA Moerbeifontein) as well as the 1:250 000 scale topographic map 3222 Beaufort West;

(b) Google Earth© satellite imagery;

(c) published geological and palaeontological literature, including 1:250 000 geological maps (3222 Beaufort West) and the relevant sheet explanation (Johnson & Keyser 1979) as well as

(d) several previous palaeontological heritage assessments (PIAs) in the Great Karoo region near Beaufort West by the author (See References under Almond), especially the Droërivier Solar Facility by Almond (2014) and the Screening Study for the Lombaardskraal Renewable Energy Facility by Almond (2020a).

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

4. An approximately two week long palaeontological field assessment of the combined JESSA WEF and Grid Connection project areas by the author and an experienced field assistant (Ms Madelon Tusenius, Natura Viva cc), during the periods 10-15 July, 22-27 August, 4 September 2021 and 25-26 October 2021. This study also incorporates field data for sectors of the Grid Connection corridors that were previously surveyed for the Droërivier Solar Facility by Almond (2014). Additional short palaeontological visits to the project area were made in the company of Professor Bruce Rubidge and Dr Marc van den Brandt (ESI, Wits University) on 16 March and 26 October 2021.

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

[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

2. OUTCOME OF SITE SENSITIVITY VERIFICATION

Provisional palaeosensitivity mapping using the DFFE Screening Tool suggests that the great majority of the combined JESSA Grid Connection project areas is of Very High palaeosensitivity, based on the widespread occurrence here of Permian age sedimentary bedrocks of the Lower Beaufort Group (Karoo Supergroup) (Figs. A3.4 to A3.6). Areas along the Gamka River Valley underlain by thick Late Caenozoic alluvium are assigned a Low palaeosensitivity.

The four-day palaaeontological site visit to the grid connection project area indicated that, in practice, well-preserved fossils of scientific and conservation interest are sparsely distributed within the Lower Beaufort Group bedrocks here. This is attributed to (a) low levels of bedrock exposure associated with those sectors that are of low relief with pervasive cover by largely unfossiliferous superficial sediments (*N.B.* some higher relief sectors display excellent bedrock exposure); (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.

A few small High Sensitivity fossil sites have been recorded within the broader project area (*N.B.* several of these have since been mitigated through specialist palaeontological collection) but most of the recorded Palaeozoic fossil sites are of limited scientific or conservation value. The pervasive Late Caenozoic cover sediments, including locally thick alluvium, are 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 of scientific literature and recent PIA reports for the Beaufort West region of the Great Karoo, **it is concluded that all the JESSA Grid Connection project areas (including the possible Droërivier MTS expansion area) are 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**.

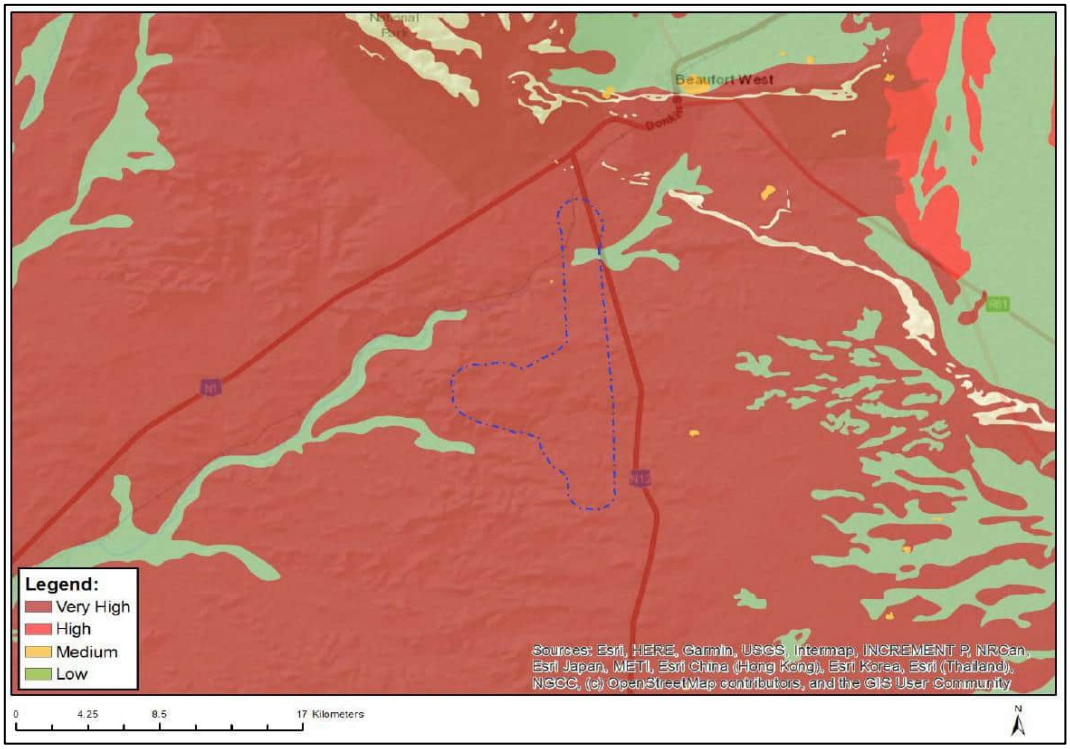

Figure A3.4: Palaeosensitivity of the JESSA M Grid Connection project area (blue polygon) based on the DFFE Screening Tool (Abstracted from screening report provided by SLR Consulting).

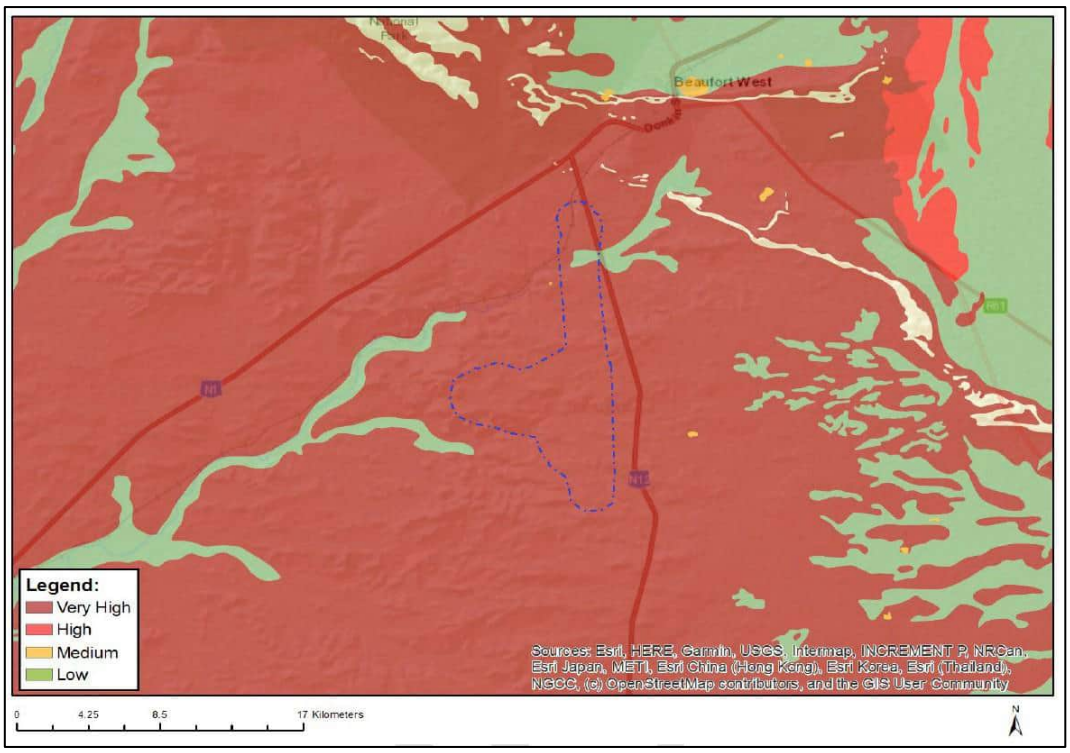

Figure A3.5: Palaeosensitivity of the JESSA Z Grid Connection project area (blue polygon) based on the DFFE Screening Tool (Abstracted from screening report provided by SLR Consulting).

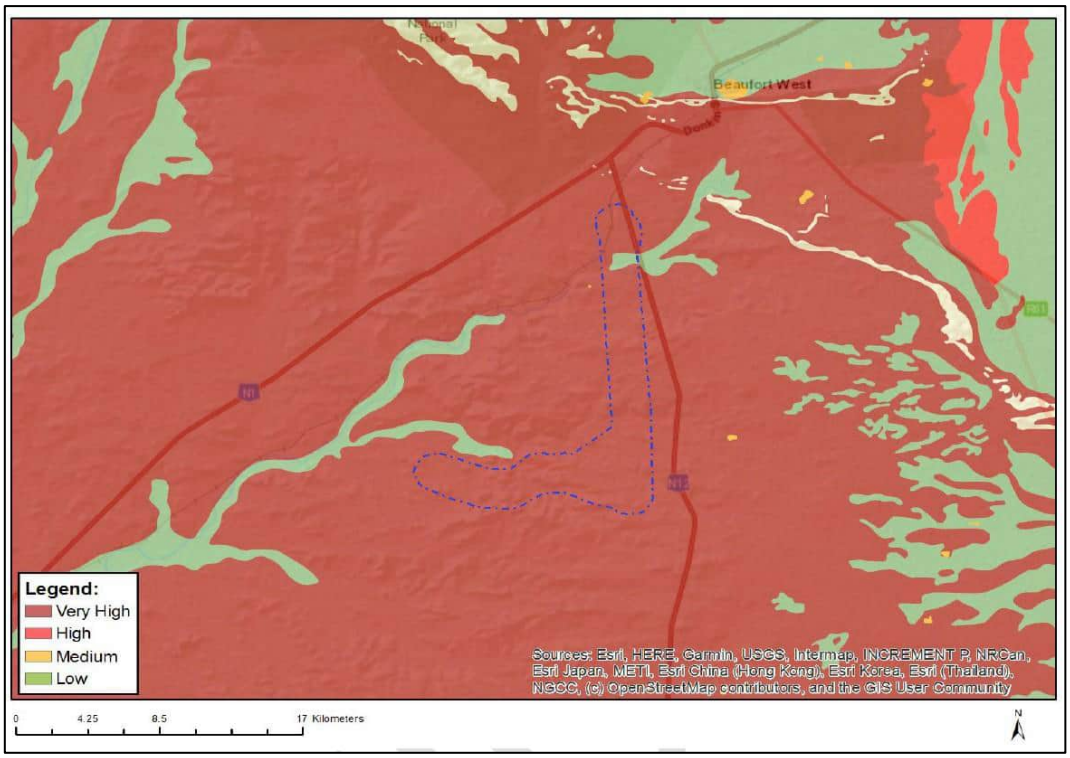

Figure A3.6: Palaeosensitivity of the JESSA S Grid Connection project area (blue polygon) based on the DFFE Screening Tool (Abstracted from screening report provided by SLR Consulting).

APPENDIX 4: Terms of Reference of the palaeontological heritage study

BASIC ASSESSMENT (BA) PROCESSES FOR THE PROPOSED JESSA WIND ENERGY FACILITY (WEF) CLUSTER & ASSOCIATED GRID CONNECTION INFRASTRUCTURE PROJECTS NEAR BEAUFORT WEST, WESTERN CAPE PROVINCE - SPECIALIST TERMS OF REFERENCE (ToR)

Jessa WEF & Associated Grid Connection Infrastructure Projects

Prepared for: ENERTRAG South Africa (Pty) Ltd

Authority References: DFFE – To be Allocated

ENERTRAG

SLR

SLR Project No.: 720.05085.P0007
Report No.: 1
Revision No.: 0.3
December 2021

DOCUMENT INFORMATION

Title	BASIC ASSESSMENT (BA) PROCESSES FOR THE PROPOSED JESSA WIND ENERGY FACILITY (WEF) CLUSTER & ASSOCIATED GRID CONNECTION INFRASTRUCTURE PROJECTS NEAR BEAUFORT WEST, WESTERN CAPE PROVINCE - SPECIALIST TERMS OF REFERENCE (ToR)
Project Manager	Alice Moropa
Project Manager Email	amoropa@slrconsulting.com
Author	Alice Moropa Stephan Jacobs
Reviewer	Liandra Scott-Shaw
Keywords	Wind, Turbine, Battery Energy Storage System, Wind Energy Facility, Substation, Powerlines, Renewables, Transmission, Distribution
Status	Draft
Report No.	1
SLR Company	SLR Consulting (South Africa) (Pty) Ltd

DOCUMENT REVISION RECORD

Rev No.	Issue Date	Description	Issued By
A	October 2021	Specialist Terms of Reference (ToR)	AM
B	December 2021	Specialist Terms of Reference (ToR)	LSS

REPORT SIGN OFF AND APPROVALS

Alice Moropa
(Project Manager)

Liandra Scott-Shaw
(Reviewer)

BASIS OF REPORT

This document has been prepared by an SLR Group company with reasonable skill, care and diligence, and taking account of the manpower, timescales and resources devoted to it by agreement with **ENERTRAG South Africa (Pty) Ltd** (the Client) as part or all of the services it has been appointed by the Client to carry out. It is subject to the terms and conditions of that appointment.

SLR shall not be liable for the use of or reliance on any information, advice, recommendations and opinions in this document for any purpose by any person other than the Client. Reliance may be granted to a third party only in the event that SLR and the third party have executed a reliance agreement or collateral warranty.

Information reported herein may be based on the interpretation of public domain data collected by SLR, and/or information supplied by the Client and/or its other advisors and associates. These data have been accepted in good faith as being accurate and valid.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

The copyright and intellectual property in all drawings, reports, specifications, bills of quantities, calculations and other information set out in this report remain vested in SLR unless the terms of appointment state otherwise.

This document may contain information of a specialised and/or highly technical nature and the Client is advised to seek clarification on any elements which may be unclear to it.

Information, advice, recommendations and opinions in this document should only be relied upon in the context of the whole document and any documents referenced explicitly herein and should then only be used within the context of the appointment.

BASIC ASSESSMENT (BA) PROCESSES FOR THE PROPOSED JESSA WIND ENERGY FACILITY (WEF) CLUSTER & ASSOCIATED GRID CONNECTION INFRASTRUCTURE PROJECTS NEAR BEAUFORT WEST, WESTERN CAPE PROVINCE - SPECIALIST TERMS OF REFERENCE (TOR)

1. INTRODUCTION

The purpose of the Terms of Reference (ToR) is to provide the specialist team with a consistent approach to the specialist studies that are required as part of the Basic Assessment (BA) processes being conducted in respect of the proposed development of the six (6) Jessa Wind Energy Facility (WEF) and associated grid connection infrastructure projects[1] near the town of Beaufort West in the Western Cape Province. This will enable comparison of environmental impacts, efficient review, and collation of the specialist studies into the respective BA reports, in accordance with the latest requirements of the EIA Regulations, 2014 (as amended).

Competent specialists, with relevant knowledge, qualification and SACNASP[2] registrations, are required to complete the relevant Specialist Assessments for the six (6) Jessa WEFs and associated grid connection infrastructure projects. The scope of the Specialist Assessments, inter alia, is to undertake compliance statements (were relevant); site sensitivity verification reports and specialist assessments as per the relevant protocols[3], to predict potential impacts resulting from the planned project activities and consider cumulative impacts on the receiving environment; and to produce appropriate management and mitigation plans required to ensure that impacts are adequately addressed. The work must assess the impacts in terms of applicable local, national, and international standards. The Specialist Assessments must be appropriate to inform the layout and operational approach of each respective WEF and grid connection infrastructure project, with management and mitigation to carry into the environmental management programme.

The approach, methods and outputs must be undertaken in accordance with the relevant/specific assessment protocols, and best practice must be applied.

2. PROJECT BACKGROUND

2.1 BACKGROUND

ENERTRAG South Africa (Pty) Ltd (herein after referred to as "ESA") has appointed SLR Consulting South Africa (Pty) Ltd (hereafter referred to as "SLR") in the role of Independent Environmental Assessment Practitioner (EAP) to undertake the Basic Assessment (BA) Processes for the proposed construction of three

[1] Jessa WEF & Grid Connection projects include the following six (6) projects: 1) Jessa M WEF & Associated Infrastructure (DFFE ref no. to be allocated); 2) Jessa M Grid Connection (DFFE ref no. to be allocated); 3) Jessa S WEF & Associated Infrastructure (DFFE ref no. to be allocated); 4) Jessa S Grid Connection (DFFE ref no. to be allocated); 5) Jessa Z WEF & Associated Infrastructure (DFFE ref no. to be allocated) and 6) Jessa Z Grid Connection (DFFE ref no. to be allocated).

[2] South African Council for Natural Scientific Professions

[3] Government Notice 320 20 March 2020- protocol for the specialist assessment and minimum report content requirements for identified environmental themes when applying for environmental authorisation, Government Notice 1150 30 October 2020- protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species and terrestrial plant species respectively and Species Environmental Assessment Guideline 2021

(3) Wind Energy Facilities (WEFs) (i.e., x3 BA processes) and three (3) associated grid connection infrastructure projects (i.e., x3 BA processes), near the town of Beaufort West in the Western Cape Province of South Africa.

The above-mentioned WEF and associated grid connection infrastructure projects form part of a greater renewable energy project known as the 'Jessa Cluster', being proposed by ESA near the town of Beaufort West. The projects which form part of the proposed 'Jessa Cluster' include the following (**Figure 1**):

- Jessa M WEF – DFFE Reference Number: To be Allocated;
- Jessa M Grid Connection – DFFE Reference Number: To be Allocated;
- Jessa S WEF – DFFE Reference Number: To be Allocated;
- Jessa S M Grid Connection – DFFE Reference Number: To be Allocated;
- Jessa Z WEF – DFFE Reference Number: To be Allocated; and
- Jessa Z Grid Connection – DFFE Reference Number: To be Allocated.

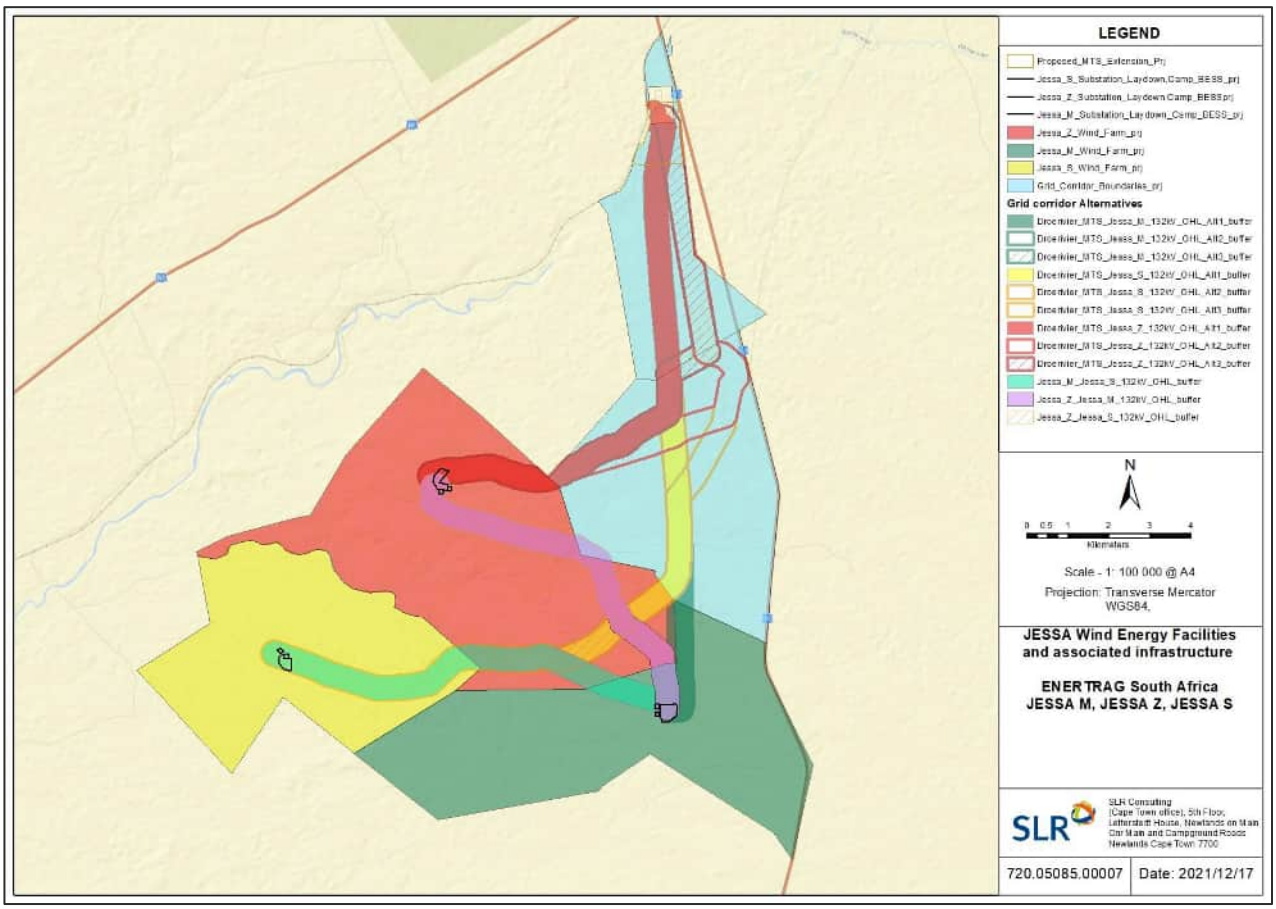

Figure 1: Map showing WEF & associated grid connection infrastructure projects which form part of proposed Jessa Cluster

The proposed WEF and grid connection infrastructure projects aim to supply and feed clean energy to public or private off-takers procured through power procurement programmes such as the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), or similar suitable private off-taker initiatives (direct supply or wheeling agreements, as applicable).

The key components of the above-mentioned WEF & associated grid connection infrastructure projects are provided in Section 4 of this ToR.

2.2 PROCESS

In terms of the Environmental Impact Assessment (EIA) Regulations of 2014 (GNR 982), as amended on 07 April 2017 [promulgated in Government Gazette 40772 and Government Notice (GN) R326, R327, R325 and R324 on 7 April 2017], various aspects of the proposed WEF & associated grid connection infrastructure developments are considered listed activities under GNR 327 (Listing Notice 1), GNR 325 (Listing Notice 2) and GNR 324 (Listing Notice 3) which may have an impact on the environment and therefore require authorisation from the National Competent Authority (CA), namely the Department of Forestry, Fisheries and the Environment (DFFE), prior to the commencement of such activities.

It should be noted that the proposed WEF and Grid Connection projects are located within the Beaufort West Renewable Energy Development Zone (REDZ) (namely REDZ 11) as well as the Central Strategic Transmission Corridor, as defined and in terms of the procedures laid out in Government Notices No. 113 and No. 145 which were formally gazetted on 16 February 2018 and 26 February 2021 respectively. The proposed projects are therefore subject to separate respective BA processes in terms of the National Environmental Management Act (NEMA): EIA Regulations of 2014, as amended. In addition, a reduced 57-day decision-making timeframe for the CA is now applicable, instead of the usual 107 days as stated in the NEMA: EIA Regulations of 2014, as amended.

A total of six (6) applications for EA (in the form of separate respective BA processes) will be undertaken for the WEFs and Grid line connections, three (3) for the WEF projects and three (3) for the grid connection infrastructure. Specialist studies have been commissioned to assess and verify the respective WEF and grid connection project sites, under the new Gazetted specialist protocols (where applicable).

3. LOCALITY AND EXTENT

The WEF and grid connection project sites are located approximately 8-15km south of the town of Beaufort West, in the Beaufort West Local Municipality of the Central Karoo District Municipality, Western Cape. The project sites are also located adjacent to the N12 road, on the farms / properties listed in **Table 1** below. **Figure 2** provides an indication of the locality of the developments.

Table 1: WEF and Grid[4] Connection Farm Portions

Project name	Farm portion & number	Farm name	21-digit code
Jessa Z WEF	Portion 1 of Farm 319	Boeteka	C00900000000031900001
	Portion 5 of Farm 319	Boeteka	C00900000000031900005
	Portion 6 of Farm 319	Boeteka	C00900000000031900006
	Portion 7 of Farm 319	Boeteka	C00900000000031900007
Jessa Z Grid Connection	Portion 0 of Farm 432	Beaufort West Road	C00900000000043200000
	Portion 10 of Farm 170	Weltevreden	C00900000000017000010
	Portion 1 of Farm 319	Boeteka	C00900000000031900001
	Portion 5 of Farm 319	Boeteka	C00900000000031900005

[4] Note that the Grid Connection farm portions are indicative of the assessment areas for all the grid connection alternative routes

Project name	Farm portion & number	Farm name	21-digit code
	Portion 6 of Farm 319	Boeteka	C00900000000031900006
	Portion 7 of Farm 319	Boeteka	C00900000000031900007
Jessa M WEF	Portion 5 of Farm 319	Boeteka	C00900000000031900005
	Portion 6 of Farm 319	Boeteka	C00900000000031900006
	Portion 0 of Farm 330	Lombards Kraal	C00900000000033000000
	Portion 0 of Farm 432	Beaufort West Road	C00900000000043200000
Jessa M Grid Connection	Portion 10 of Farm 170	Weltevreden	C00900000000017000010
	Portion 0 of Farm 330	Lombards Kraal	C00900000000033000000
	Portion 1 of Farm 319	Boeteka	C00900000000031900001
	Portion 5 of Farm 319	Boeteka	C00900000000031900005
	Portion 6 of Farm 319	Boeteka	C00900000000031900006
Jessa S WEF	Portion 0 of Farm 319	Boeteka	C00900000000031900000
Jessa S Grid Connection	Portion 0 of Farm 432	Beaufort West Road	C00900000000043200000
	Portion 10 of Farm 170	Weltevreden	C00900000000017000010
	Portion 0 of Farm 319	Boeteka	C00900000000031900000
	Portion 1 of Farm 319	Boeteka	C00900000000031900001
	Portion 5 of Farm 319	Boeteka	C00900000000031900005

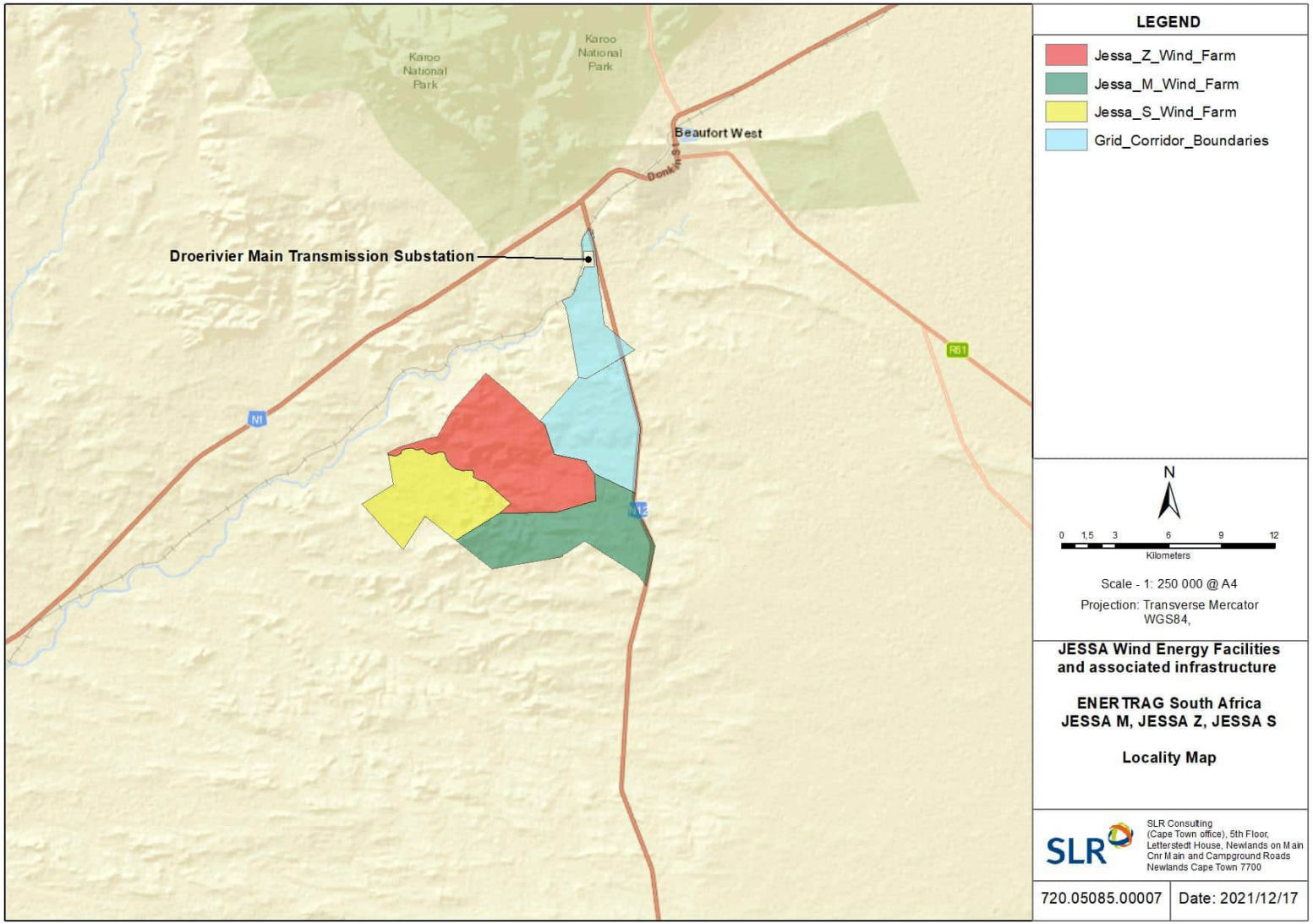

Figure 2: Jessa WEFs and Grid Connection Locality

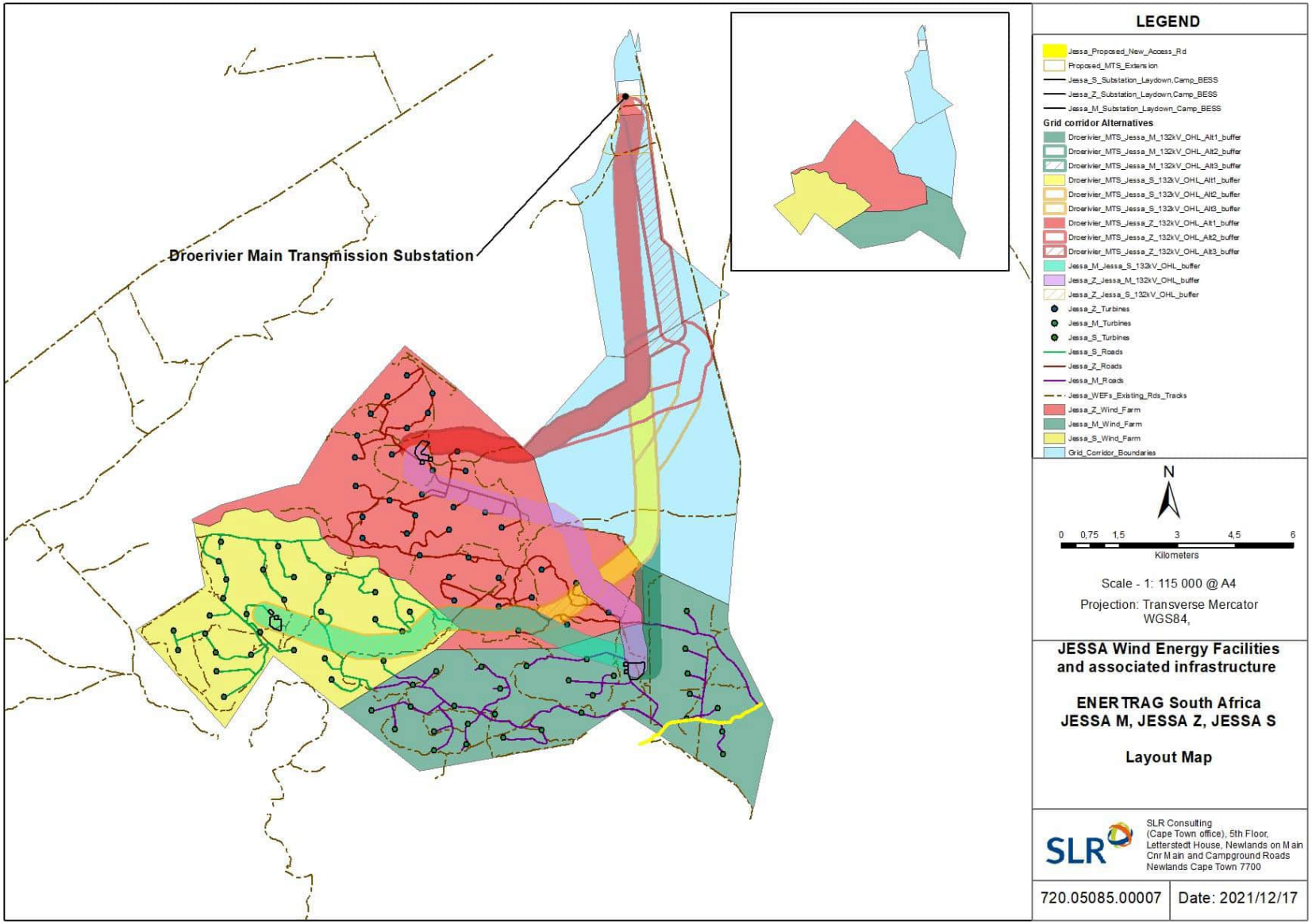

Figure 3: Jessa WEFs and Grid Connection Layout

4. PROJECT DESCRIPTION

ESA is proposing to construct three (3) WEFs (with varying generation capacities) as well as three (3) associated grid connection infrastructure projects, near the town of Beaufort West in the Western Cape Province. The above-mentioned WEF and associated grid connection infrastructure projects form part of a greater renewable energy project known as the 'Jessa Cluster', being proposed by ESA near the town of Beaufort West. The projects which form part of the proposed 'Jessa Cluster' include the following (**Figure 1**):

- 220MW Jessa M WEF – DFFE Reference Number: To be Allocated;
- Jessa M Grid Connection – DFFE Reference Number: To be Allocated;
- 203.5MW Jessa S WEF – DFFE Reference Number: To be Allocated;
- Jessa S M Grid Connection – DFFE Reference Number: To be Allocated;
- 220MW Jessa Z WEF – DFFE Reference Number: To be Allocated; and
- Jessa Z Grid Connection – DFFE Reference Number: To be Allocated.

The WEF projects include wind turbines with associated infrastructure such as access and internal roads, Operations & Maintenance (O&M) buildings, a cement batching plant, a temporary laydown or staging area, substations, internal underground / overhead cables and a BESS component (of up to 220MW/880MWh). Once built, the proposed projects are intended to connect directly to the nearby existing Eskom Droërivier Main Transmission Substation (MTS) through a powerline of up to 132 kilovolts (kV) (either single or double circuit).

The grid connection infrastructures projects include overhead powerlines (either single circuit or double circuit), switching stations and access roads. The grid connection infrastructures projects will service the above-mentioned Jessa WEF projects. The proposed Grid Connection projects will also involve the possible expansion of the existing Droërivier MTS.

The proposed WEF and grid connection infrastructure projects aim to supply and feed clean energy to public or private off-takers procured through power procurement programmes such as the REIPPPP, or similar suitable private off-taker initiatives (direct supply or wheeling agreements, as applicable).

The technical details of the proposed WEF and Grid Connection projects are provided in the sections below.

4.1 PROJECT TECHNICAL DETAILS – WEF PROJECTS

ESA is proposing to develop three (3) WEFs (with varying generation capacities), namely the Jessa Z WEF; Jessa M WEF and Jessa S WEF. Each WEF project will include the following key components to facilitate the generation of electricity at a large scale:

- Up to 35 wind turbines for Jessa Z WEF project;
- Up to 29 wind turbines for Jessa M WEF project;
- Up to 28 wind turbines for Jessa S WEF project;
- Internal overhead and underground cables (up to 33kV);
- A construction camp per WEF;
- Operation and Maintenance (O&M) buildings per WEF;

- An onsite high voltage collector substation (33kV/132kV) per WEF project, covering an area of up to 4ha to allow for the potential of multiple feeder bays of up to 132kV, as well as transformers, a control building, telecommunication infrastructure and access roads; and
- A battery energy storage system (BESS) of up to 200MW/800MWh per WEF project. The BESS includes batteries, a power conversion system and transformer and will be placed on a platform that covers approximately 10ha.

As mentioned, all three (3) WEF projects will consider a BESS (which includes batteries, a power conversion system and transformer) which will be placed on a platform that covers an area approximately 10 hectares (ha) in extent. It is proposed that Lithium Battery Technologies (such as Lithium-Ion Phosphate and Lithium Nickel Manganese Cobalt oxides) or Vanadium Redox flow technologies will be considered as the preferred battery technology. The specific technology will however only be determined following Engineering, Procurement and Construction (EPC) procurement.

The proposed WEF projects aim to generate electricity from a renewable resource (namely wind energy) to feed into the national grid.

4.2 PROJECT TECHNICAL DETAILS - GRID CONECTION PROJECTS

The proposed Grid Connection infrastructure projects require several key components to facilitate the distribution and transmission of electricity at a large scale, which includes the following

- An onsite high voltage collector substation (33kV/132kV) per Grid Connection project, to allow for the potential of multiple feeder bays of up to 132kV, as well as transformers, control building, telecommunication infrastructure and access roads;
- 132kV powerlines (either single or double circuit), connecting each WEF project to each other via the substations;
- 132kV transmission lines from each WEF substation to the existing Eskom Droërivier MTS; and
- Upgrades to the existing Eskom Droërivier MTS (within the current footprint); or
- If required, an expansion / additional 132kV/400kV MTS (approx. 20ha in extent).

ESA proposes to connect all three (3) WEF projects to the nearby existing Eskom Droërivier MTS through powerlines, transmitting up to 132kV (either single or double circuit). The proposed grid connection projects therefore aim to feed the electricity generated by the proposed Jessa WEF projects into the national grid.

To allow efficient transmission, the electricity generated by the wind turbines undergoes a voltage 'step-up' process that occurs at each wind turbine, where power is stepped up to a maximum of 33kV (either in the turbine or in a small transformer container next to the turbine) and again at each WEF substation where power is stepped up to 132kV. The power is then transferred through a switching station (next to each WEF substation) along a 132kV line where it will connect into the Droërivier MTS and will form part of the national grid.

It is expected that the combined assessed project area (for all WEF and Grid Connection projects) will cover an area of approximately 13 000ha. The project components and technical details for the WEF and Grid Connection projects are listed in Table 2 below.

Table 2: Project Technical Details

Component	Details
Turbines	1. Turbine numbers: Jessa M WEF = up to 29 ; Jessa S WEF = up to 28 and Jessa Z WEF = up to 35 2. Rotor diameter: up to 200m with a hub height of up to 200m (for all 3 WEFs) 3. Maximum export capacity (MW) for each WEF: a. Jessa M WEF: 220MW b. Jessa Z WEF: 220MW c. Jessa S WEF: 203.5MW
Foundations	1. Foundation dimensions (for all 3 WEFs): Approximately 25m diameter x 3m deep, depending on the site-specific geotechnical conditions at the turbine locations. Larger dimensions may also be required.
Access roads	1. Site access (for all 3 WEFs): via an existing access points from the N12, or via new access roads, as determined by the traffic engineer. Right of Way (ROW) access will need to cross the Jessa M WEF and will be granted via a contract for the projects. 2. Access road(s) to the project sites and internal roads between project components will be developed within a corridor of 20m wide, to allow for fluctuating road widths as necessitated by cable trenches, stormwater channels and turning circle / bypass areas. 3. Existing roads will be upgraded wherever possible, although new roads will be constructed where necessary.
On-site Substations	1. Each project will have an onsite substation of 33/132kV, including a transformer. 2. Palisade fencing of 3m height will be placed around the substation complex encompassing the onsite buildings, as per Eskom's specifications.
Construction camps	1. Each project will include a construction camp with alternative locations for each project. 2. Typical area: 100m x 50m = 5000m^2. 3. The camps will use portable toilets and sceptic tanks during the construction phase.
Temporary construction laydown / staging areas	1. Each project will include a laydown area. 2. Approximately 22000m^2. Laydown area could increase to 30000m^2 for concrete towers, should they be required. 3. Possible concrete batching plant at each WEF
Operation and Maintenance (O&M) buildings	1. Each project will include O&M buildings, to be located in close proximity to each project onsite substation. 2. The total combined area of the buildings will not exceed 5000m^2
Masts (if applicable)	1. The overall project site has existing MET masts.
Boreholes and storage tanks (if applicable)	1. The use of onsite boreholes, as far as technically possible, if water quality standards are met. To be decided upon with landowner. 2. Storage tanks 3. Other water source alternatives will be considered, including water supply from the local Municipality or bulk water supplier in the region 4. Temporary water containment tanks (i.e., Jojo tanks) may be used during the construction phase for water supply, whilst permanent tanks may be placed above the O&M buildings
Battery Energy Storage Systems	1. It is proposed that Lithium Battery Technologies (such as Lithium-Ion Phosphate and Lithium Nickel Manganese Cobalt oxides) or Vanadium Redox flow technologies will be considered as the preferred battery technology. The specific technology will however be determined by the appointed contractor. 2. The systems will have capacities of up to 200MW/800MWh.

4.3 PROJECT ALTERNATIVES

4.3.1 WEF Projects

A comprehensive iterative design process has been undertaken to inform the layout for the proposed WEF projects. In addition, the layout of the proposed projects will be informed by the identified environmental sensitive and/or 'no-go' areas. All highly sensitive and/or 'no-go' areas identified by the specialists will be avoided by the project infrastructure and all recommended buffer areas respected. As such, no layout alternatives will be considered and assessed for the WEF projects.

It should also be noted that a site area of up to approximately 300 000m^2 (i.e., 550m x 550m or approximately 30ha) will be assessed for the placement onsite substation, BESS, laydown area, O&M building and 33kV overhead powerlines which form part of each WEF project.

4.3.2 Grid Connection

A site area of up to approximately 300 000m^2 (i.e., 550m x 550m or approximately 30ha) will also be assessed for the switching station portion of the substation[5] and connection of the associated powerlines which form part of each Grid Connection project.

In addition, as part of the site area, three (3) 132kV powerline route alternatives will be assessed for each Grid Connection project, to link each proposed Jessa WEF project to the existing Eskom Droërivier MTS (see Figures 4-6 below). Powerline corridors with widths of 600m (i.e., 300m on either side of centre line) are being considered and assessed for the powerline route alternatives, to allow flexibility when routing the proposed powerlines within the authorised corridors.

It should be noted that only one (1) of the above-mentioned powerline corridor route alternatives will be required per Grid Connection project and thus the specialist is required to indicate whether one (1) of these alternatives has a preference over the others (including reasons for preferences).

[5] Laydown, O&M buildings, ablutions and BESS will also be located within the 30ha footprint and is included in the respective Jessa WEF projects.

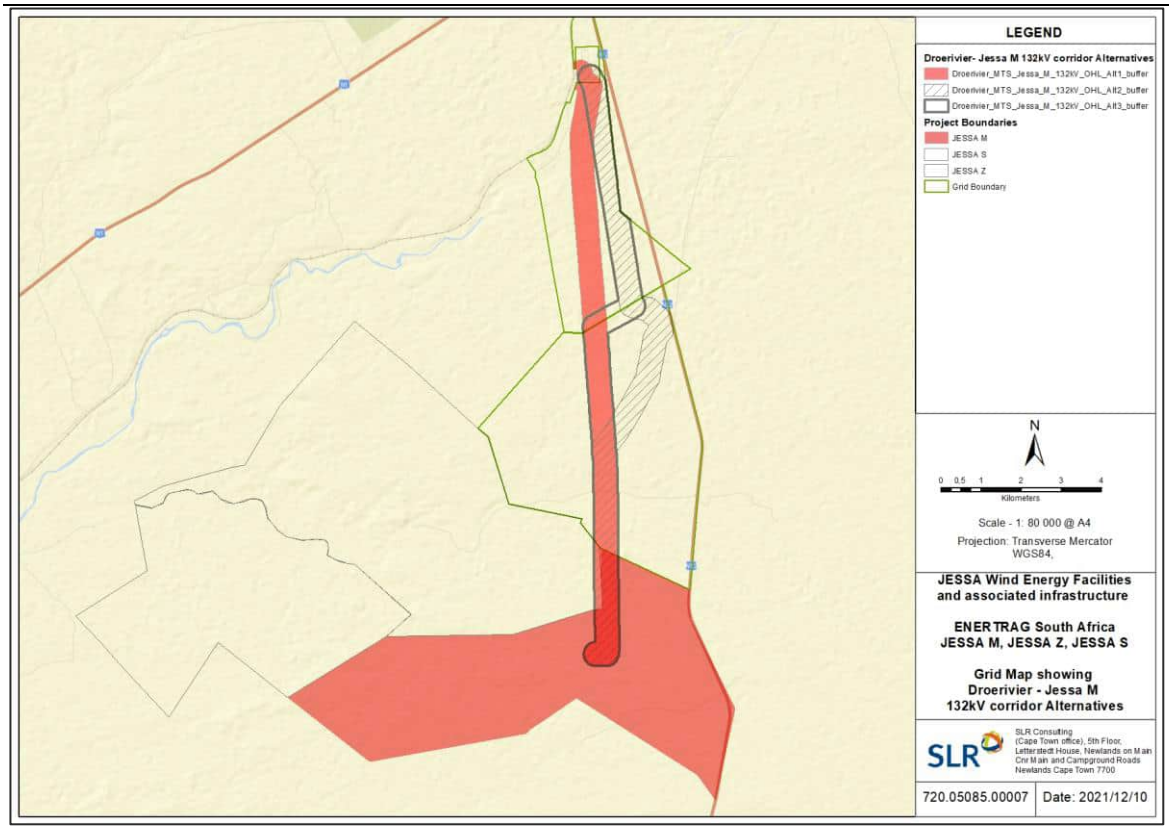

Figure 4: Powerline route alternatives to link proposed Jessa M WEF project to existing Eskom Droërivier MTS

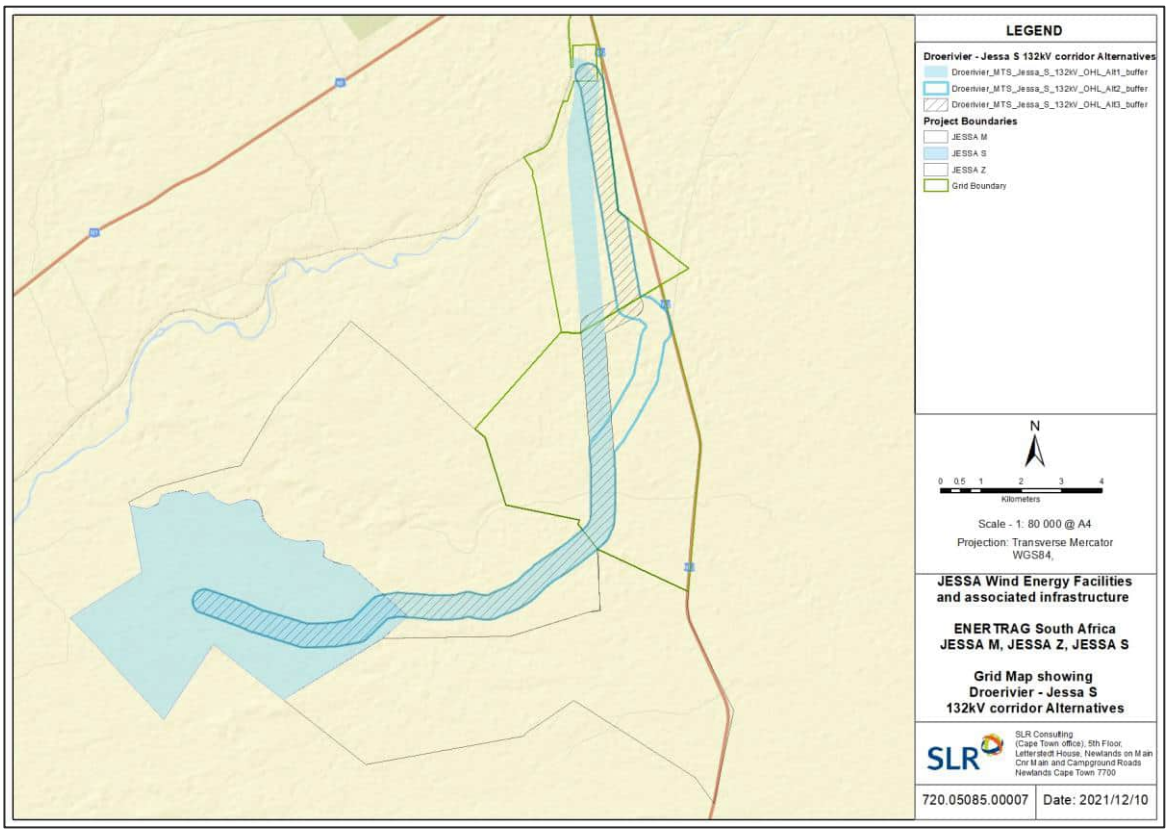

Figure 4: Powerline route alternatives to link proposed Jessa S WEF project to existing Eskom Droërivier MTS

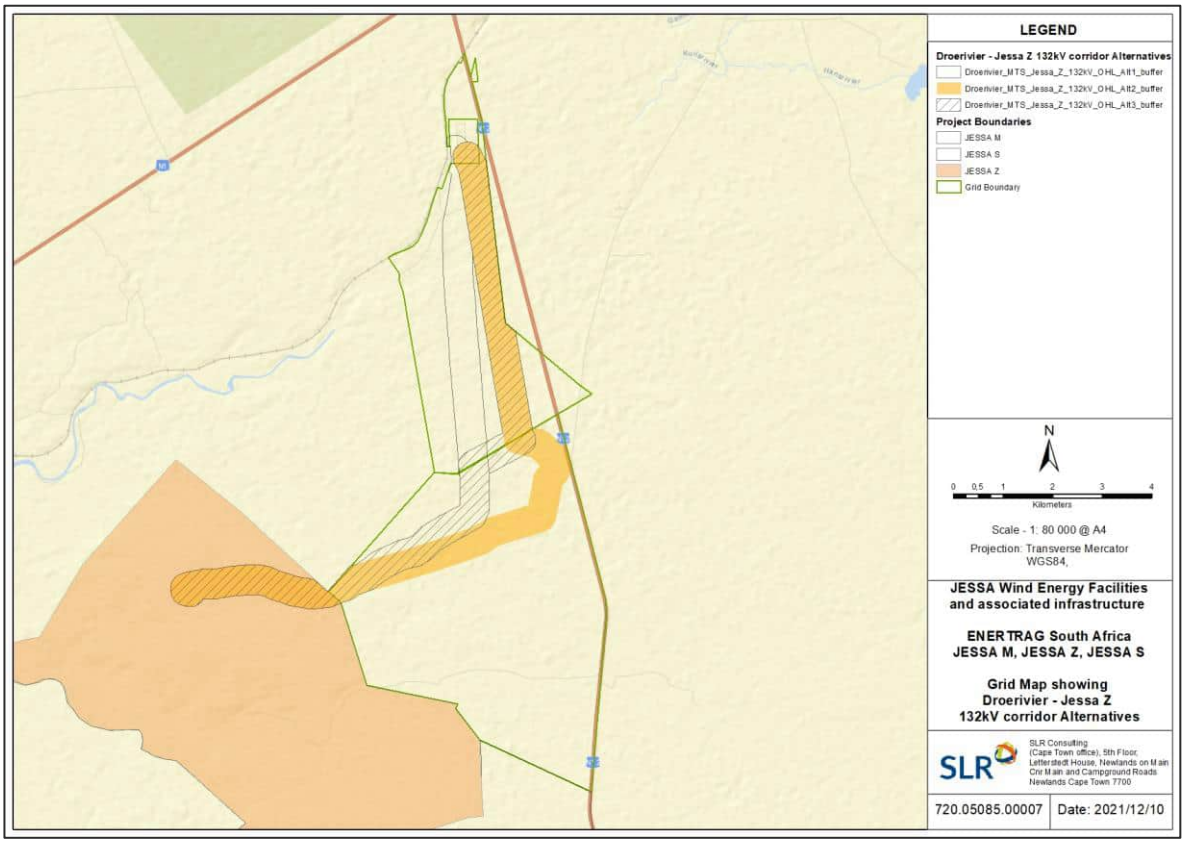

Figure 6: Powerline route alternatives to link proposed Jessa Z WEF project to existing Eskom Droërivier MTS

In addition to the powerline route alternatives to link the proposed Jessa WEF projects to the existing Eskom Droërivier MTS mentioned above, three (3) 132kV WEF connecting grid corridors to link the respective Jessa WEF projects (i.e., Jessa M – Jessa S; Jessa Z – Jessa M and Jessa Z to Jessa S) are also being assessed and proposed for authorisation (see Figure 7 below). Powerline corridors with widths of 600m (i.e., 300m on either side of centre line) have been considered and assessed for these WEF connecting grid corridors as well, to allow flexibility when routing the proposed powerline within the authorised corridors.

It should be noted that the Grid Connection projects are intrinsically linked to the WEF projects and three (3) WEF connecting grid corridors are required to ensure that the respective Jessa WEF projects connect to various collector substations, which will feed electricity generated by the WEF projects into the national grid via 132kV powerlines connecting to the Droërivier MTS (Figure 7). As such, all three (3) WEF connecting grid corridors being assessed will need to be authorised by the DFFE, to allow the respective Jessa WEF projects to connect to the national grid, should one (1) of the proposed grid connection infrastructure projects not received EA.

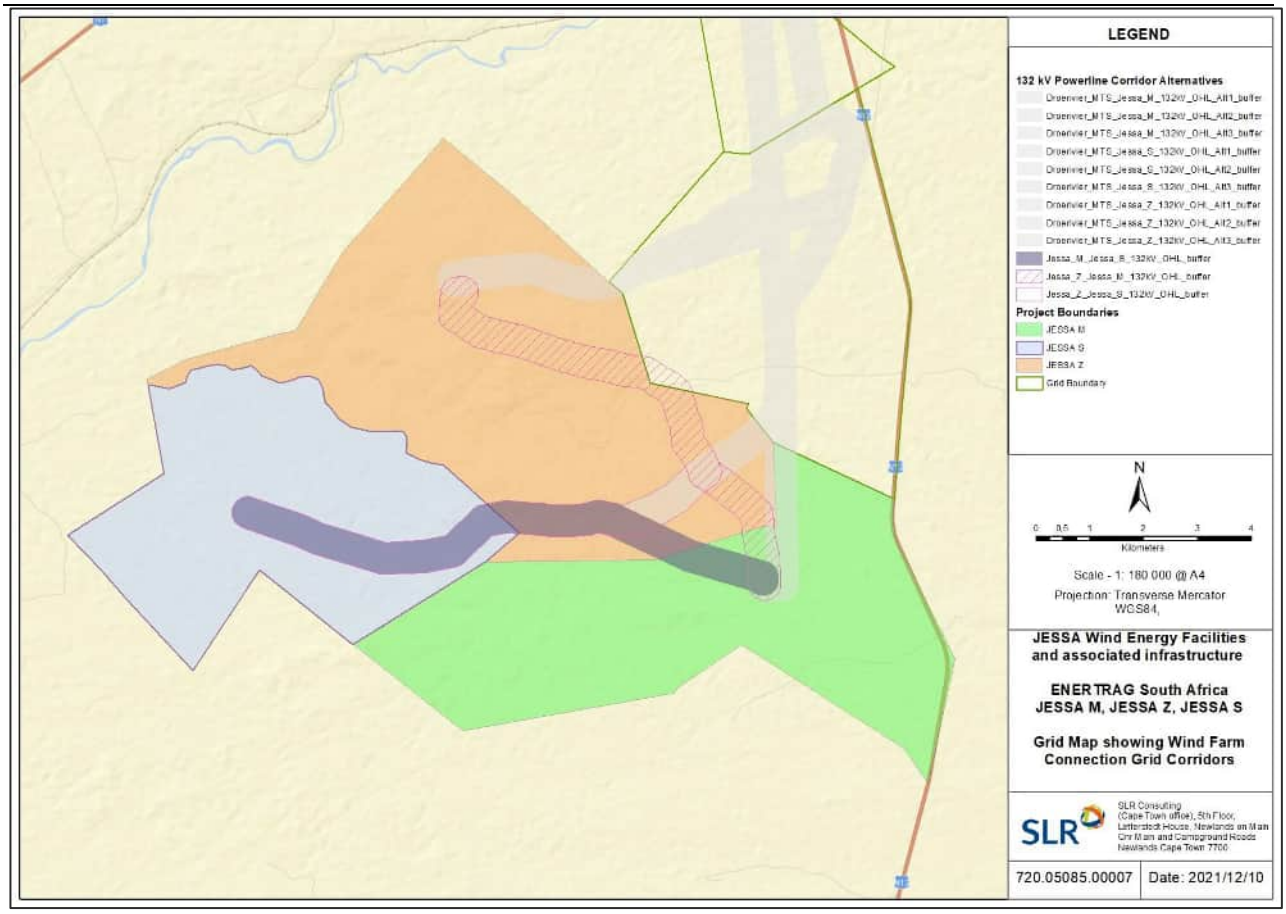

Figure 7: WEF connecting grid corridors to link proposed Jessa M, Jessa S and Jessa Z WEF projects

4.3.3 Main Transmission Substation (MTS) Expansion

As an alternative to connecting directly to the existing Eskom Droërivier MTS, ESA will explore the possible expansion of the MTS. A 20-30ha area will therefore be assessed for this purpose, over portion 10 of Farm Weltevreden which is located near the existing Eskom MTS.

The possible MTS expansion area which is being proposed and assessed are shown in Figure 3.

4.3.4 'No-Go' Alternative

The 'no-go' alternative is the option of not constructing the three (3) Jessa WEFs and three (3) associated grid connection infrastructure projects, where the *status quo* of the current status and/or activities on the project sites would prevail. This alternative would result in no additional impact on the receiving environment.

Should the 'No-Go' alternative be considered, there would be no impact on the existing environmental baseline and no benefits to the local economy and affected communities. The alternative also bears the opportunity cost of missed socio-economic benefits to the local community that would otherwise realise from establishing the farms which form part of the project sites. The option of not developing also entails that the bid to provide renewable / clean energy to the national grid and contribute to meeting the country's energy demands will be forfeited.

5. SPECIALIST STATEMENT / REPORT REQUIREMENTS

The section below details the structure and content to be included in the specialist reports.

5.1 PROJECT DESCRIPTION

The specialist report must include the project description as provided above.

5.2 METHODOLOGY

The report must include a description of the methodology applied in carrying out the specialist assessment.

5.3 SPECIALIST FINDINGS / IDENTIFICATION OF IMPACTS

The report must present the findings of the specialist studies and explain the implications of these findings for the respective proposed WEF and grid connection infrastructure developments (e.g. permits, licenses etc.). This section of the report should also identify any sensitive and/or 'no-go' areas on the respective development sites which should be avoided.

The reports should be accompanied with spatial datasets (shapefiles, KML) and accompanying text documents, if required.

5.4 IMPACT RATING METHODOLOGY

The impacts of the proposed developments (during the Design, Construction, Operation and Decommissioning phases) are to be assessed and rated according to the methodology developed by SLR. Specialists will be required to make use of the impact rating matrix provided (in Excel format) for this purpose. Both the Impact Methodology (including Cumulative Impacts) and the rating matrix will be provided by SLR.

Please be advised that this section must include mitigation measures aimed at minimising the identified impacts of the proposed WEF and Grid Connection infrastructure developments.

5.5 INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM (EMPr)

The report must include a description of the key monitoring recommendations for each applicable mitigation measure identified for each phase of the respective WEF and Grid Connection developments, for inclusion in the Environmental Management Program (EMPr) or Environmental Authorisation (EA) for each respective project.

Please make use the Impact Rating Table (in Excel format) provided for each of the phases (i.e., Design, Construction, Operation and Decommissioning).

5.6 CUMULATIVE IMPACT ASSESSMENT

A cumulative impact assessment must be undertaken for each respective proposed development, in order to determine the cumulative impact that will materialise should other Renewable Energy Facilities (REFs) with their associated powerlines and substations (i.e., powerline infrastructure) and large-scale industrial developments be constructed within 30km of the proposed WEF and grid connection development sites.

The cumulative impact assessment must contain the following:

- A cumulative environmental impact statement noting whether the overall impact is acceptable; and
- A review of the specialist reports undertaken for other REFs and powerline infrastructure developments [including the cumulative impacts of each of the WEFs (Jessa M, S & Z) on each other), including an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered.

To assist the specialists in this regard, SLR will provide the following documentation / data:

- A summary table listing all REFs and associated powerline infrastructure developments identified within 35km of the proposed developments; and
- Relevant KML files.

It should be noted that it is the specialist's responsibility to source the relevant EIA / BA reports that are available in the public domain. SLR will assist, where possible.

The list of renewable energy facilities that must be assessed as part of the cumulative impact will be provided.

Table 3: Neighbouring WEF developments

Development	Distance
Beaufort West Solar Power Plant Site 1 - 14/12/16/3/3/2/772 as amended	10km
Beaufort West Solar Power Plant Site 2 - 14/12/16/3/3/2/772 as amended	10km
Beaufort West Solar Power Plant Site 3 - 14/12/16/3/3/2/774 as amended	10km
Beaufort West Photovoltaic Park - 12/12/20/2286 as amended	20km
19MW PV Solar Facility on Portion 1 of Steenrotsfontein 168 - 12/12/20/2133 as amended	8km

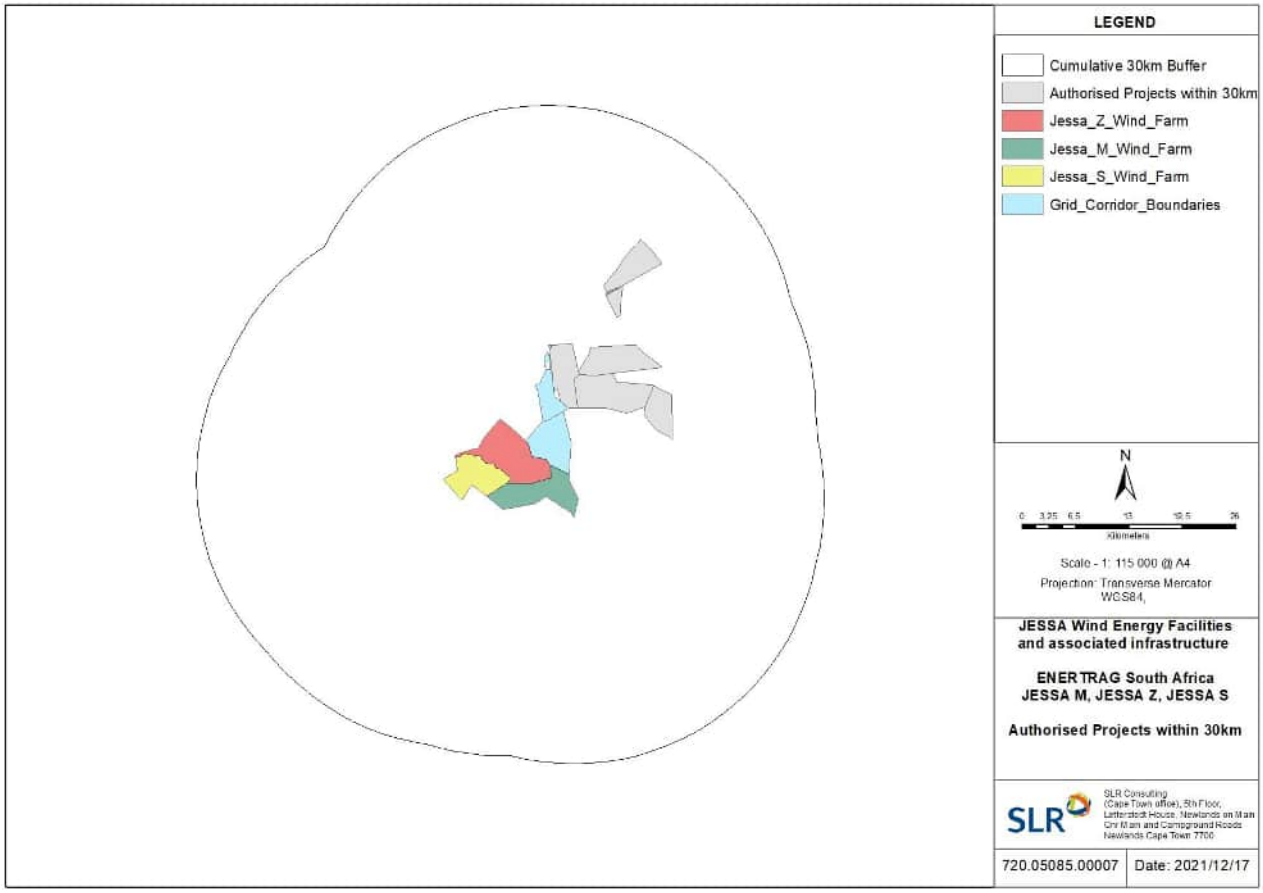

Figure v: Cumulative map showing Renewable Energy projects within 30km radius

It should be noted that the following applications for EA which were identified within a 35km radius of the proposed project site have been withdrawn and/or have lapsed:

- Proposed wind and solar facility on Farm Lombaardskraal, Farm 330, Beaufort West, Western Cape (14/12/16/3/3/2/406);
- Proposed PV solar plants on three (3) properties, Beaufort West, Western Cape (14/12/16/3/3/2/324; 14/12/16/3/3/2/325; 14/12/16/3/3/2/326 & 14/12/16/3/3/2/327); and
- Proposed 300MW PV solar energy facility on the Farm Streenrotsfontein near Beaufort West, Western Cape (12/12/20/2441).

5.7 'NO-GO' ALTERNATIVE

Consideration must be given to the 'no-go' option in the respective BA processes. The 'no-go' option assumes that the respective project sites remain in their current state, i.e., there is no construction of WEFs (including associated infrastructure) and associated grid connection infrastructure in the proposed project area and the *status quo* would proceed.

5.8 COMPARATIVE ASSESSMENT

A comparative assessment of the proposed powerline route alternatives (to link each proposed Jessa WEF project to the existing Eskom Droërivier MTS) for each respective grid connection project will need to be considered and assessed in each specialist study. Thus, each specialist is required to nominate the preferred

powerline route alternative for each respective the grid connection infrastructure project. The preferred powerline route alternative will be premised on what the specialist deems the most environmentally feasible alternative.

As mentioned, all three (3) WEF connecting grid corridors mentioned in section 4.3.2 (namely Jessa M – Jessa S; Jessa Z – Jessa M and Jessa Z - Jessa S) are required to allow the respective Jessa WEF projects to connect to the national grid, should one (1) of the Jessa grid connection infrastructure projects not receive EA. The specialist must therefore confirm whether any fatal flaws exist and whether the three (3) WEF connecting grid corridors are deemed acceptable for authorisation.

In addition, the 20-30ha area for the possible expansion of the MTS over portion 10 of Farm Weltevreden must also be assessed as an alternative to connecting directly to the existing Eskom Droërivier MTS. The specialist must confirm whether the area proposed for the possible expansion of the MTS is deemed acceptable for this purpose and whether any fatal flaws exist in this regard.

5.9 CONCLUSION / IMPACT STATEMENT

The conclusion section of the specialist reports must include an Impact Statement, indicating whether any fatal flaws have been identified for any of the respective projects and ultimately whether the three (3) proposed WEFs and three (3) Grid Connection infrastructure projects can be authorised or not (i.e., whether EA should be granted for any one or all developments, or not).

5.10 EXECUTIVE SUMMARY

Specialists must provide an Executive Summary which summarises the findings of their report, to allow for easy inclusion in the BA Reports (Draft and Final Reports).

6. DELIVERABLES

All specialists will need to submit the following deliverables:

- Site Verification Reports (1 for each WEF project and 1 for each grid connection infrastructure project)
- Draft constraints map / 'no-go' / sensitivity layers
- 1 x draft Specialist Report / Compliance Statement for the three (3) WEF projects (1 combined report for all 3 projects) and 1 x draft Specialist Report / Compliance Statement for the three (3) grid connection infrastructure projects (1 combined report for all 3 projects) (as required under GN 320 and GN 1150), with separate impact rating sections, no later than the 19 November 2021.
- Final Specialist Reports / Compliance Statements no later than 10 January 2021.The final reports will include an Impact Assessment that assesses the revised layouts which considers the sensitivity layers provided by each specialist.
- A copy of the specialist's Curriculum Vitae (CV).
- A copy of the Specialist Declaration of Interest (DoI) form, containing original signatures. This form will be provided to the specialists. **Please note that the undertaking / affirmation under oath section of the report must be signed by a Commissioner of Oaths**.
- All data relating to the studies, such as shapefiles, photographs and maps.

7. GENERAL SUBMISSION REQUIREMENTS

Please ensure that your specialist report includes the following:

- The Site Verification Reports and Compliance Statements / Specialist Reports must be in line with the DFFE Screening Tool Specialist Theme Protocols (as gazetted in GN 320 20 March 2020 and GN 1150 30 October 2020), should they apply. Should they not apply, the reports must be written in accordance with Appendix 6 of the EIA Regulations, 2014 (as amended);
- A table cross referencing how the requirements for specialist reports have been adhered to according to Appendix 6 of the EIA Regulations, 2014 (as amended), or requirements specified in GN R320 & GN 1150 must be provided at the beginning of your reports. An MS Word version will be provided by SLR;
- A thorough overview of all applicable legislation, policies, guidelines etc.;
- Identification of sensitive and/or 'no-go' areas to be avoided;
- Recommend mitigation measures in order to minimise the impact of the proposed developments;
- Provide implications of specialist findings for the proposed developments (e.g. permits, licenses etc.);
- Specify if any further assessment will be required;
- Include an Impact Statement, concluding the following:
    - whether all of the proposed powerline route alternatives can be authorised or not (i.e. whether EA should be granted for 1 or all alternatives or not).
    - whether the three (3) WEF connecting grid corridors are deemed acceptable for authorisation.
    - whether the area proposed for the possible expansion of the MTS is deemed acceptable for this purpose and whether any fatal flaws exist in this regard.
- A copy of the specialist's Curriculum Vitae (CV); and
- A copy of the Specialist Declaration of Interest (DoI) form, containing original signatures, must be appended to all Draft and Final Reports. This form will be provided to the specialists. **Please note that the undertaking / affirmation under oath section of the report must be signed by a Commissioner of Oaths**.

8. TIMEFRAMES

- Site Verification Report and Compliance Statement / Draft Specialist Reports no later than 19 November 2021.
- Final specialist reports addressing comments received from the client / SLR and with any changes arising based on revised site layouts (revised based on the constraints / site sensitivity maps) and stakeholder engagement no later than 10 January 2021.

9. REPORT / DATA FORMATS

- All specialist reports must be provided in MS Word format;
- Where maps have been inserted into the reports, SLR will require a separate map set in PDF format for inclusion in our submission;
- Where figures and/or photos have been inserted into the reports, SLR will require the original graphic in .jpg format for inclusion in our submission; and

- Delineated areas of sensitivity must be provided in either ESRI shapefile format or Google Earth KML format. ***Sensitivity classes must be included in the attribute tables with a clear indication of which areas are 'No-Go' areas***. SLR will provide sensitivity classes. **Only areas rated to be of Very High (VH) sensitivity should be regarded as 'No-Go' areas. Further to this, infrastructure relevant to the identified 'No-Go' areas should be specified in the attribute table (i.e., No-Go areas in the attribute table must be specified for the different infrastructure- turbines, substations, powerlines, and buildings).**

RECORD OF REPORT DISTRIBUTION

SLR Reference:	720.05085.P0007
Title:	Basic Assessment (BA) processes for the proposed Jessa Wind Energy Facility (WEF) & Associated Grid Connection Infrastructure Projects near Beaufort West, Western Cape Province - Specialist Terms of Reference (ToR)
Report Number:	1
Client:	ENERTRAG South Africa (Pty) Ltd

AFRICAN OFFICES

South Africa

CAPE TOWN
T: +27 21 461 1118

JOHANNESBURG
T: +27 11 467 0945

DURBAN
T: +27 11 467 0945

Ghana

ACCRA
T: +233 24 243 9716

Namibia

WINDHOEK
T: + 264 61 231 287

APPENDIX 5: CHANCE FOSSIL FINDS PROTOCOL

<table>
<tr><th colspan="3">JESSA GRID CONNECTION PROJECTS NEAR BEAUFORT WEST, WESTERN CAPE</th></tr>
<tr><td>Province & region:</td><td colspan="2">Western Cape (Central Karoo District): Beaufort West Local Municipality</td></tr>
<tr><td>Responsible Heritage Resources Agency</td><td colspan="2">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>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 tetrapod burrows, trackways, petrified wood, plant-rich beds in the Lower Beaufort Group bedrocks. Fossil mammal bones, teeth, horn cores, freshwater molluscs, plant material, trace fossils 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 for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
• Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
• Photograph fossils against a plain, level background, with scale
• Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
• Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
• Alert Heritage Resources 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">Obtain Fossil Collection Permit (SAHRA) / Work Plan approval (HWC) from relevant Heritage Resources Agency. 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>