Appendix H.9

PALAEONTOLOGICAL ASSESSMENT

COMBINED DESKTOP & FIELD-BASED PALAEONTOLOGICAL HERITAGE STUDY:

PROPOSED MURA PV SOLAR FACILITIES BETWEEN LOXTON AND BEAUFORT WEST, BEAUFORT WEST LOCAL MUNICIPALITY (CENTRAL KAROO DISTRICT MUNICIPALITY), WESTERN CAPE AND UBUNTU LOCAL MUNICIPALITY (PIXLEY KA SEMA DISTRICT MUNICIPALITY), NORTHERN CAPE

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EXECUTIVE SUMMARY

Red Cap Energy (Pty) Ltd is proposing to develop four solar facilities and associated grid connections, on behalf of four separate Project Applicants, collectively known as the Mura PV projects, between Loxton and Beaufort West in the Beaufort West Local Municipality, Western Cape Province and the Ubuntu Local Municipality, Northern Cape Province.

Each of the four Mura PV Solar projects and associated Electrical Grid Infrastructure (EGI) project area is underlain by continental sediments of the Teekloof Formation (Poortjie and Hoedemaker Members) within the Lower Beaufort Group, Karoo Supergroup). Fossil assemblages of the *Endothiodon* Assemblage Zone of latest Middle to earliest Late Permian age are associated with the Lower Beaufort Group beds mapped within most or all of the combined project area; however, representatives of the older *Tapinocephalus* Assemblage Zone might also be present within the lower parts of the Poortjie Member (unconfirmed). These fossils record the recovery phase on land from the end-Middle Permian Mass Extinction Event of c. 260 million years ago.

A six-day palaeontological site visit, supported by desktop studies drawing on previous field-based palaeontological studies in the wider region, indicates that fossils of scientific and conservation significance – most notably well-preserved vertebrate remains – are very sparse indeed in this region (See data provided in Appendix 1). This is probably due, at least in part, to (1) the effects of the end-Middle Permian Mass Extinction Event, (2) the generally low to very low levels of sedimentary bedrock exposure, especially within the low-relief Mura PV Solar 1-4 project areas (most fossil sites occur in gullied hillslopes and along major drainage lines which form only a very minor part of the combined project area) and (3) Early Jurassic dolerite intrusions which have compromised fossil preservation in some sectors of the combined project area, including sectors of the western EGI corridors, through thermal metamorphism and associated hydrothermal processes (*e.g.* circulation of hot, mineralising ground waters). No fossil sites have been recorded within the Late Caenozoic superficial sediments (alluvium, colluvium *etc*).

It is concluded that the four Mura PV Solar projects and EGI corridor, including the footprints of all associated infrastructure (*e.g.* access road network) is, in practice, of LOW Palaeosensitivity, although the potential for unrecorded fossil sites of high scientific value cannot be entirely discounted. The provisional Medium to Very High Palaeosensitivity mapped by the DFFE Screening Tool is accordingly *contested* here. Impacts on local palaeontological heritage resources due to the proposed solar and EGI developments are anticipated to be of Low significance before mitigation and Very Low significance following mitigation. Cumulative impacts are likely to be of Low to Very Low Significance in the context of other renewable energy developments proposed for the region (*viz*. Nuweveld WEF Cluster, Gamma Grid Line) and fall within acceptable limits. There are no objections on palaeontological heritage grounds to the authorisation of the proposed 4 Mura PV Solar developments or the associated EGI.

No recorded fossil sites of unique scientific or conservation value are likely to be directly impacted by the proposed renewable energy and electrical infrastructure developments and no further palaeontological studies or mitigation is proposed here with regard to these sites. **Pending the discovery of significant new fossil finds before or during construction, no further specialist palaeontological studies, monitoring or mitigation are recommended for these renewable energy and electrical infrastructure projects.** Any new fossil sites revealed during the Construction Phase of the developments are best handled by the Chance Fossil Finds Protocol appended to this report (Appendix 2) which should be included within the EMPrs for the developments.

Where Pre-construction or Construction Phase mitigation, comprising palaeontological recording and collection of fossil material and associated geological data, is triggered by chance fossil finds, this must be carried out by a suitably qualified palaeontological specialist under a Fossil Collection Permit (SAHRA) for Mura Solar 3 and the small portion of the EGI corridor located in the Northern Cape and an approved Work Plan to Heritage Western Cape for Mura Solar 1, 2, and 4, and remaining portions of the EGI corridor, falling in the Western Cape, issued by the relevant Heritage Resources Management Agency. The fossil material collected must be curated in an approved repository (*e.g.* museum / university collection). Standards for palaeontological reporting and mitigation in the RSA have been established by Heritage Western Cape (2016, 2021) and SAHRA (2013).

1. INTRODUCTION & PROJECT OUTLINE

Red Cap Energy (Pty) Ltd is proposing to develop four solar facilities and associated grid connections, on behalf of four separate Project Applicants, collectively known as the Mura PV projects, between Loxton and Beaufort West in the Beaufort West Local Municipality (Central Karoo District Municipality), Western Cape Province and the Ubuntu Local Municipality (Pixley ka Seme District Municipality), Northern Cape Province (Figure 1). The proposed Mura PV Solar projects are located in close proximity to the approved Nuweveld Wind Farm Development. The four solar facilities and associated infrastructure (access road network, and grid connection) are addressed in this combined specialist palaeontological heritage compliance report.

The Mura PV project sites will be accessed via the R381, DR02317 and existing access roads. Each solar facility will connect to the Eskom grid *via* a new 132 kV overhead line connecting the two on-site solar substations *via* adjacent Eskom switching stations to the approved Nuweveld Collector substation.

For the grid connection, an EGI Corridor is proposed and will be assessed as part of a separate Basic Assessment Process. The grid corridor includes multiple connection routes of up to two 132 kV overhead lines running in parallel and switching stations to enable the connection of the Mura Solar Development to the approved Nuweveld Collector Substation. The Corridor includes a "collector ring line". This implies that it is a circular grid line and not just a single line between the Nuweveld Collector Substation.

According to provisional sensitivity mapping using the DFFE screening tool, the project areas for the four proposed PV solar developments, including the associated access roads and grid connections, is largely of Very High palaeosensitivity (Section 5). In accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a combined field-based and desktop palaeontological heritage site sensitivity verification (SSV) has been undertaken in order to confirm or contest the environmental sensitivity of the proposed project areas as identified by the DFFE National Web-Based Environmental Screening Tool.

The Independent Environmental Practitioner co-ordinating the various environmental impact assessment processes for the proposed development (EIA Assessment and Scoping Report) is WSP in Africa, Midrand (Contact details: Ms Ashlea Strong and Ms. Megan Govender. Address: WSP in Africa

Building 1, Golder House, Maxwell Office Park, Magwa Crescent West, Waterfall City, Midrand South Africa. Tel: +27 011 361 1300. E-mail: Ashlea.Strong@wsp.com and Megan.Govender@wsp.com).

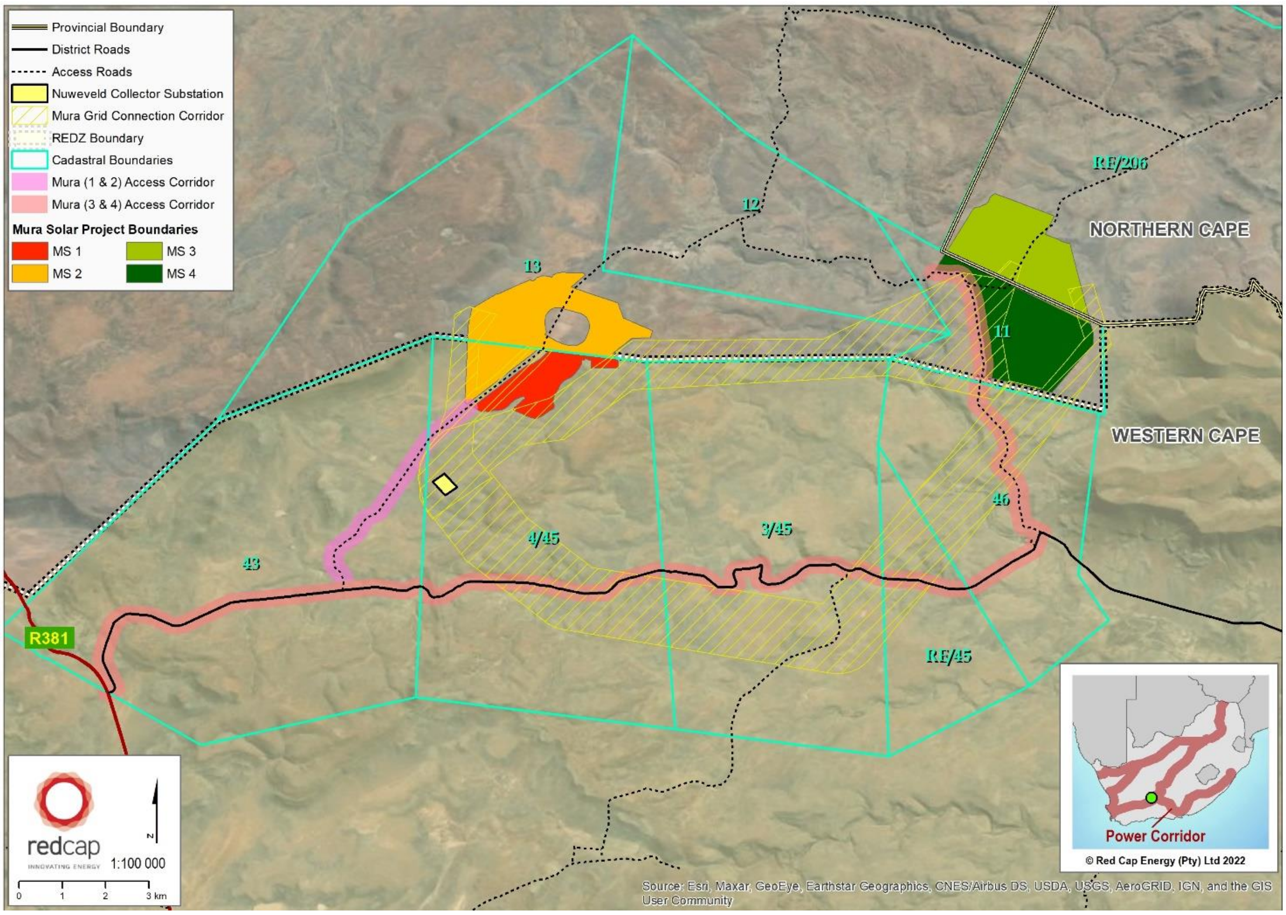

Figure 1: Project locality map of the Mura Solar PV Development situated between Loxton and Beaufort West in the Western and Northern Cape Provinces.

1.1. Solar PV project components and specifications

The following are proposed as part of each project. It should be noted that the areas under consideration for each solar project site should be assumed to be wholly transformed and will contain the following:

A. Solar Field, comprising Solar Arrays:

- Maximum height of 6 m;
- PV Modules that are located on either single axis tracking structures or fixed tilt mounting structures or similar

B. Solar Farm Substation:

- Maximum height of 12m;
- Two up to 150 m x 75 m substation yards that will include:
  - Substation building; and
  - High voltage gantry.

C. Building Infrastructure:

- Maximum height of 8m;
- Offices;
- Operational and maintenance (O&M)/ control centre;
- Warehouse/workshop;
- Ablution facilities; and
- Converter/inverter stations.

D. Li-ion or similar solid state Battery Energy Storage System (BESS):

- Each solar farm will have up to a 3.5 ha area for a 240 MWac BESS;
- BESS substation (same specifications as the solar farm substations)
- Connected to the solar farm sub/switching stations via an underground high voltage cable.

E. Other Infrastructure located within the solar area footprint:

- Internal underground cables of up to 132 kV;
- Internal gravel roads;
- Fencing (between 2 – 3 m high) around the PV Facility;
- Panel maintenance and cleaning area;
- Storm water management system; and
- Up to two construction site camps (incl. batching plant).

F. Associated Infrastructure (outside the solar area footprint but part of each solar project's application):

- Internal access gravel roads will have a 2-4 m wide driving surface and may require side drains on one or both sides. During construction the roads may be up to 12m wide but this will be a temporary impact and rehabilitated following the construction phase
- Up to two construction site camps (incl. batching plant) located within the access road corridor with a total area of up to 4.4 ha.

Electrical Grid Infrastructure (EGI) Corridor Components This will be covered in separate applications to the Solar PV facilities.

- Eight Eskom Switching stations:
  - Located adjacent to the solar farm substations within the solar area footprint;
  - Maximum height of 12m;
  - Footprint of up to 150 m x 75 m.
- Four additional up to 150 m x 75 m switching stations located within the corridor;

- ~70 km of overhead 132 kV lines (~40 km will be single overhead 132 kV line and ~30 km will be up to two overhead 132 kV lines running in parallel running between the switching stations supported by monopole pylons with a max height 38m); and
- Access tracks.

Table 1. Project specific information (Solar PV projects)

Project Name	Project Extent (full area to be transformed)	Road Access Area (existing roads to be upgraded) (incl. construction camps)	Generation capacity	Affected Farm portions
Mura Solar Project 1	**176 ha**	**21 ha**	**Up to 150 MW**	• **Leeuwkloof Farm 43** • **Portion 4 of Duiker Kranse Farm 45**
Mura Solar Project 2	**506 ha**	**21 ha**	**Up to 400 MW**	• **Leeuwkloof Farm 43** • **Portion 4 of Duiker Kranse Farm 45** • **Bultfontein Farm 13**
Mura Solar Project 3	**436 ha**	**41 ha**	**Up to 320 MW**	• **Leeuwkloof Farm 43** • **RE of Abrams Kraal Farm 206** • **Portion 4 of Duiker Kranse Farm 45** • **Portion 3 of Duiker Kranse Farm 45** • **RE of Duiker Kranse Farm 45** • **Sneeuwkraal Farm 46** • **Aangrensend Abramskraal Farm 11**
Mura Solar Project 4	**466 ha**	**40 ha**	**Up to 360 MW**	• **Leeuwkloof Farm 43** • **Aangrensend Abramskraal Farm 11** • **Portion 4 of Duiker Kranse Farm 45** • **Portion 3 of Duiker Kranse Farm 45** • **RE of Duiker Kranse Farm 45** • **Sneeuwkraal Farm 46**

Table 2. Project specific information (EGI)

Project Components	Description	Disturbance footprint
Switching stations	There will be up to two Eskom switching stations on each solar farm with a footprint of approximately 150 x 75 m (11,250 m^2). The switching station area will include all the standard switching station electrical equipment/components, such as bus bars, metering equipment, switchgear, and will also house control, operational, workshop and storage buildings/areas. Additional switching stations are also proposed outside of the solar farm footprint.	13

Overhead lines and pylons	~70 km of overhead 132 kV lines (~40 km will be single overhead 132 kV lines and ~30 km will be up to two overhead 132 kV lines running in parallel running between the switching stations supported by monopole pylons with a max height 38m. The spans (distance between pylons) on the monopole pylons (without stays) are on average 260 m.	2,5
Access roads and tracks	Existing access roads and tracks (upgraded to ± 2-4 m wide where needed) will be used as far as possible and new access tracks would be created where needed (±2-4 m wide). These are required for all project phases.	32
Temporary areas	Temporary laydown areas will be identified along the alignment, with the main equipment and construction yards being located along the alignment or based in one of the surrounding towns or at the solar site camp. It is anticipated that the total area required for the temporary laydown areas is up to 2 ha and two will be required.	4
Total disturbance footprint:	**Temporary**	4
Total disturbance footprint:	**Permanent**	48
	TOTAL	52

Project Name	Affected Farm portions
Mura EGI Corridor	• **Leeuwkloof Farm 43** • **Bultfontein Farm 13** • **Portion 4 of Duiker Kranse Farm 45** • **Portion 3 of Duiker Kranse Farm 45** • **Portion 12 of Bultfontein Farm 387** • **Aangrensend Abramskraal Farm 11** • **RE of Abrams Kraal Farm 206** • **RE Sneeuwkraal Farm 46** • **RE of Duiker Kranse Farm 45** • **Portion 2 of Paardeberg Farm 49**

2. DATA SOURCES

This palaeontological heritage site sensitivity verification report for the proposed Mura renewable energy and grid infrastructure developments is based on:

- A short project description, kmz files, project map, DFFE screening reports, high resolution satellite imagery and other relevant background documentation provided by Red Cap.

- A desktop review of (a) 1:50 000 scale topographic maps (3122CD Dunedin and 3122DC Hillcrest) and the 1:250 000 scale topographic map (sheet 3122 Port Victoria West), (b) Google Earth© and additional high resolution satellite imagery, (c) published geological and palaeontological literature, including 1:250 000 geological map sheet 3122 Victoria West and relevant sheet explanation (Le Roux & Keyser 1988) as well as (d) several previous desktop and field-based fossil heritage (PIA) assessments in the broader Beaufort West – Loxton region, including the Nuweveld WEF and Grid Connection project areas, by the author and colleagues (*e.g.* Almond 2020a, 2020b, 2022c. See also references therein).

- A four-day palaeontological heritage study of the broader Mura PV, access road and Grid Connection project area by the author and an experienced assistant during the period 1 July- to 6

July 2022 *plus* an additional two-day palaeontological site visit to the project area by the author on 22 and 23 September 2022. Fieldwork focussed largely on areas of good bedrock exposure (especially mudrock facies) previously identified using Google Earth© satellite imagery, with some attention also paid to good sections through Late Caenozoic superficial deposits (*e.g.* consolidated older alluvium).

The season of the site visit did not have any marked influence on the observations made and conclusions reached in this study.

3. GEOLOGICAL CONTEXT

The geology of the Mura PV Solar and Gridline Corridor project areas is outlined on 1: 250 000 geological sheet 3122 Victoria West (Council for Geoscience, Pretoria) (Figure 4) with a short accompanying explanation by Le Roux & Keyser (1988). Illustrated accounts of portions of the combined project area have already been provided in previous PIA reports by the author for the Nuweveld Cluster WEFs and Nuweveld Gamma Grid Connection (Almond 2020a, 2020b, Almond 2022c).

The project area is situated in the west-central sector of the Main Karoo Basin of the RSA and is largely underlain at depth by continental (fluvial / lacustrine) sediments of the **Lower Beaufort Group** / **Adelaide Subgroup** (Karoo Supergroup) of latest Middle to earliest Late Permian age (*c*. 260 to 256 Ma = million years ago). According to the current 1: 250 000 geological map, which probably requires revision, the Beaufort Group sedimentary succession represented within the project area is assigned to the lower part of the **Teekloof Formation** - *viz*. the sandstone-dominated, prominent-weathering **Poortjie Member** and the overlying mudrock-dominated, more recessive weathering **Hoedemaker Member** (Figure 28). Although this remains to be confirmed, it is considered likely that the bedrocks directly underlying the solar PV and EGI project footprints can be largely assigned to the upper part of the Poortjie Member and the lower part of the Hoedemaker Member. Large portions of the Beaufort Group outcrop have been extensively baked and mineralised by voluminous intrusions of the Early Jurassic **Karoo Dolerite Suite** in the vicinity, such as the major sills capping the Harpuisberg in the west, the Perdeberg in the east and the Taaibosberg to the north (Duncan & Marsh 2006). The palaeoenvironmentally and palaeobiologically critical boundary between the Middle and Late Permian Periods at *c*. 260 Ma lies within the lower part of the Poortjie Member (Figure 30). The **Oukloof Member** sandstone package overlying the Hoedemaker Member is not mapped within the project area itself but occurs just outside this on higher hillslopes on the Perdeberg in the east and Vaalkop in the west.

It is noted that the member-scale lithostratigraphy and associated biostratigraphical zonation of the Lower Beaufort Group succession in this sector of the Main Karoo Basin - including the long-distance correlation of the main channel sandstone packages such as the Poortjie Member - remains unresolved (*cf* Day & Rubidge 2020a, Almond 2022c). The diachronous contact between the Poortjie and Hoedemaker Members in the western sector of the study area is transitional over an interval some 25-30 m. It is marked here by the Reiersvlei Meanderbelt package identified by Smith (1987, 2021) and is of considerable palaeontological as well as palaeoenvironmental interest. The precise level of the contact is arbitrary to an extent and has been variously interpreted in maps and scientific literature (*cf* Figures 2 & 3). On the 1: 250 000 geological map (Figure 4) the entire Reiersvlei Meander Belt seems to have been incorporated within the upper Poortjie Member which extends well up the lower slopes of Perdeberg (Figures 2,3 and 47). Smith and Keyser (1995) place the contact at the top of the last thick, multistorey channel sandstone of the Poortjie Member (excluding the Reiersvlei package). The stratigraphic column in Maharaj *et al.* (2019) appears to place the contact at the incoming of thick reddish mudrock packages above Reiersvlei Meanderbelt 2, while the column in Smith *et al.* (2021) places it lower down within a red bed succession at the level of Meanderbelt 1 of the Reiersvlei package. Given these ambiguities, the stratigraphic position of the geological and fossil sites mentioned in this report provisionally follows that shown on the published 1: 250 000 geological map.

The Poortjie – Hoedemaker transition zone characterised by a succession of thin, single-storey channel sandstones and intervening, predominantly reddish-brown mudrocks (Smith & Keyser 1995, Paiva 2015, Maharaj et al. 2019, Smith *et al.* 2021). This stratigraphic interval records the transition from thick, multi-storey channel sandstones dominated by downstream accretion process typical of the Poortjie Member to laterally accreting, meandering river systems of the Hoedemaker Member. The transition is accompanied by more frequent development of crevasse splay deposits and calcareous palaesols on the floodplain driven by increased aridification in the Karoo Basin and aggradation of the Reiersvlei Meanderbelt sedimentary prism (Maharaj *et al.* 2019, Smith *et al.* 2021). In contrast, a subsidence-driven transition is favoured by Paiva (2015).

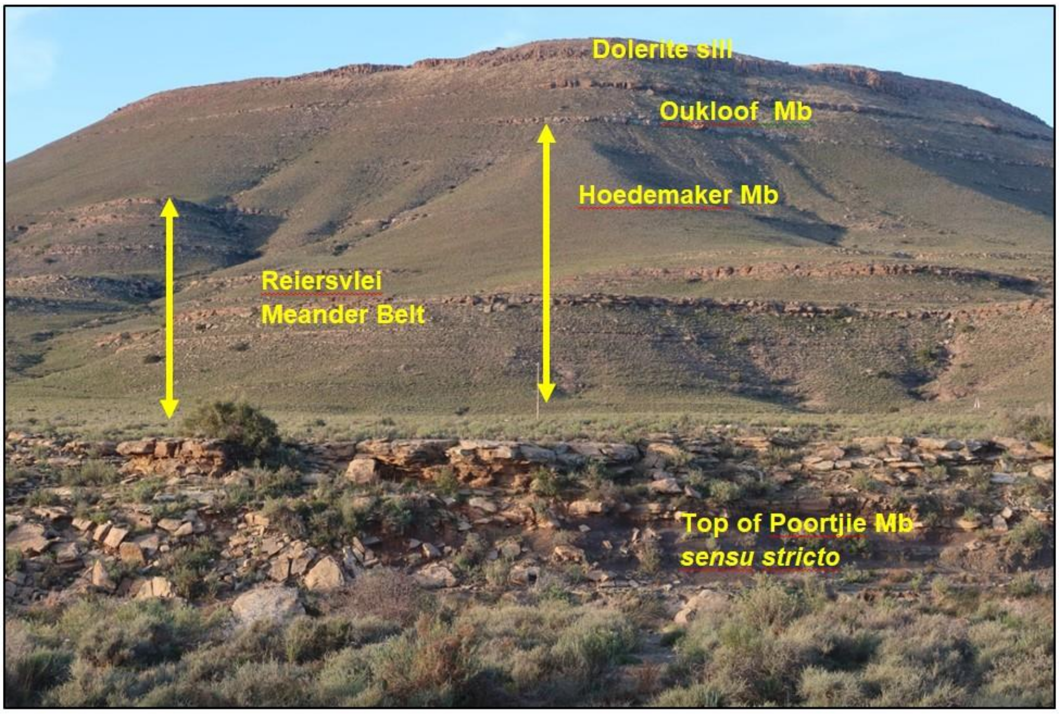

Figure 2: South-western slopes of Perdeberg near Booiskraal homestead showing one possible interpretation of the main lithostratigraphic subunits of the lower Teekloof Formation that are represented in the broader project area. The Reiersvlei Meanderbelt package is provisionally included within the base of the Hoedemaker Member here. Previous mapping included it within the upper Poortjie Member while it has been variously partitioned between the members by other workers (see text for discussion and following figure).

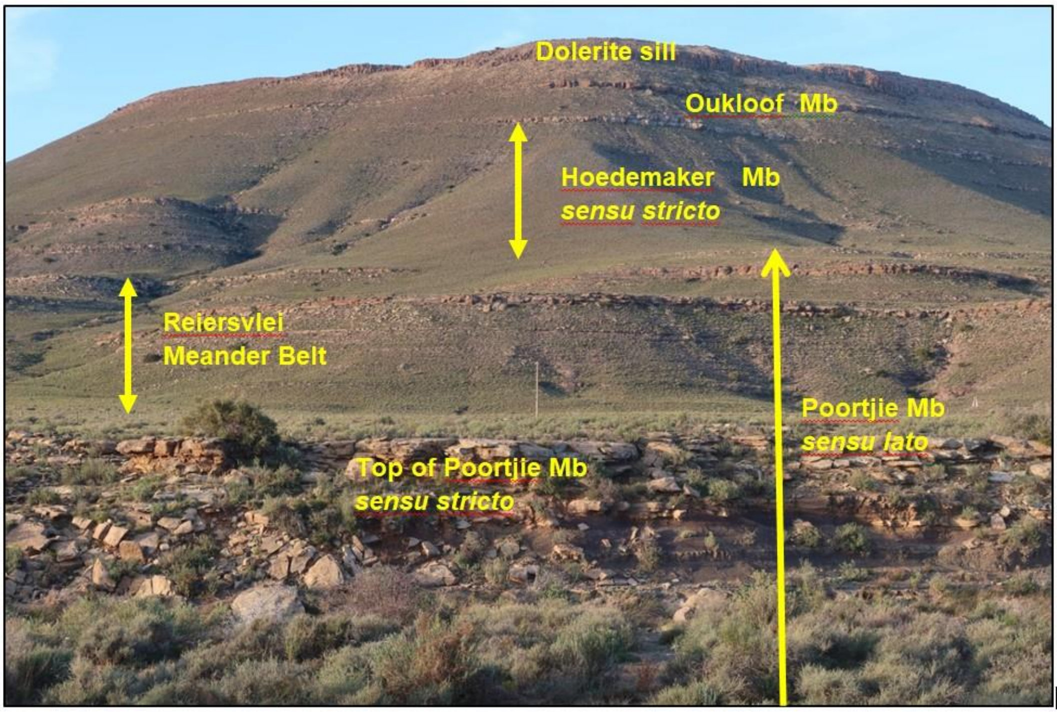

Figure 3: Alternative stratigraphic subdivision of the Lower Beaufort Group succession on Perdeberg. Here the Reiersvlei Meander Belt sandstones are included within the upper part of the Poortjie Member *sensu lato* (as mapped by the Council for Geoscience on the 1: 250 000 geology sheet 3122).

The Permian sediments and Jurassic intrusions within the combined project area are extensively mantled by a range of **Late Caenozoic superficial deposits**, limiting exposure levels of fresh (unweathered), potentially fossiliferous Permian sediments, especially in low-relief lowlands and on upland plateaux where the PV solar sites will be located. In addition to thick, consolidated (calcretised) to unconsolidated, gravelly to silty alluvial sediments along major active or defunct drainage lines (*e.g.* Kromrivier, Soutrivier and their various tributaries), these younger cover sediments include pan deposits (*e.g.* shallow *brak-kolle*), colluvial (slope) and eluvial (downwasted) surface gravels, pedocretes (*e.g.* calcrete), spring deposits and a spectrum of mainly sandy to gravelly soils. Coarse older alluvial deposits ("High Level Gravels") are not separately mapped within the project area at 1: 250 000 scale but elevated terrace gravels of Pleistocene and younger age are present along major drainage lines such as along the deeply-incised valley of the Kromrivier.

Representative images of rock exposures within the broader Mura PV solar and EGI project areas are given below in Figures 6 to 27, together with explanatory figure legends.

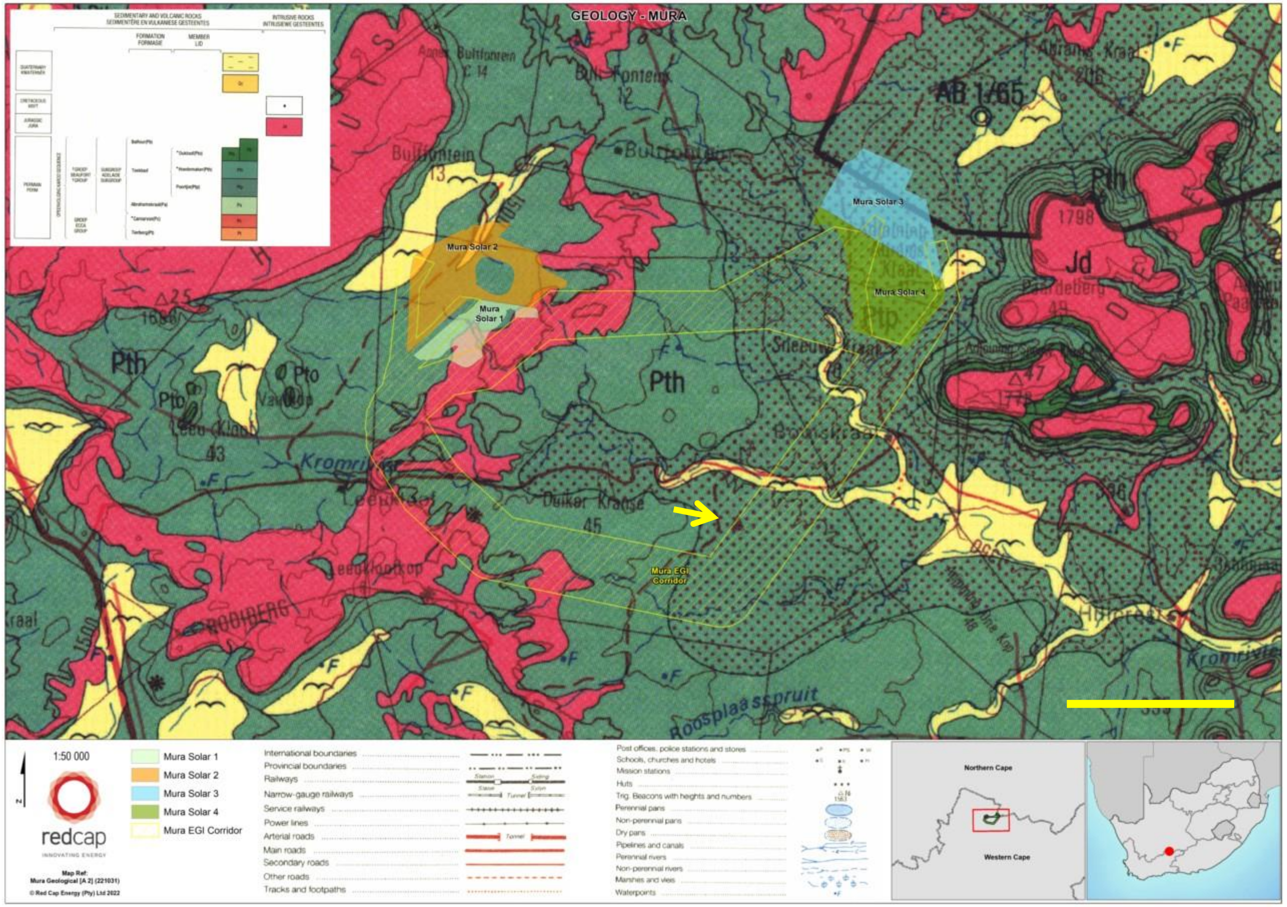

Figure 4: Extract from 1: 250 000 geology sheet 3122 Victoria West showing the combined project area for the Mura PV Solar 1 to 4 project areas and associated EGI Corridor, Western and Northern Cape Provinces (Base map published by the Council for Geoscience, Pretoria. Image provided by Red Cap). The main rock units represented here include: Ptp (middle green with stipple) = Middle to Late Permian Poortjie Member, Teekloof Formation (Adelaide Subgroup). Pth (middle green without stipple) = Late Permian Hoedemaker Member, Teekloof Formation (Adelaide Subgroup). Pto (middle green without stipple) = Late Permian Oukloof Member, Teekloof Formation (Adelaide Subgroup). Jd (red) = sills and dykes of the Early Jurassic Karoo Dolerite Suite. Pale yellow with flying bird symbol = Late Caenozoic (Neogene / Pleistocene to Recent) alluvium. *N.B.* The mapping of the various stratigraphic subunits of the Lower Beaufort Group shown here is currently contested and may require considerable revision in future, based on detailed field mapping and collection of additional biostratigraphic data. In particular, the contact between the Poortjie and Hoedemaker Members is equivocal. Scale bar (bottom RHS) = 4 km. One historical fossil site (small black triangle), since collected, is indicated by the yellow arrow.

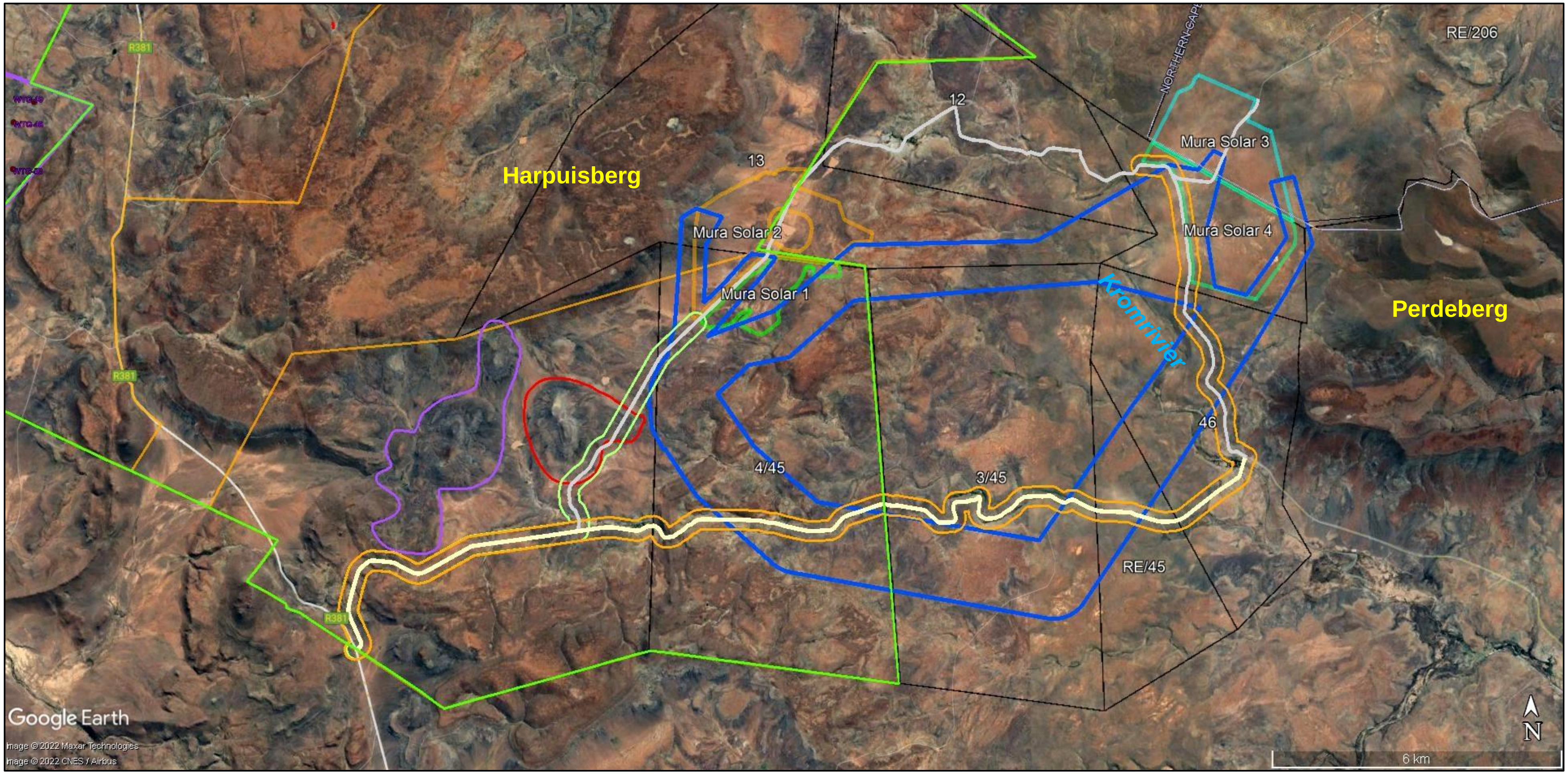

Figure 5: Google Earth© satellite image of the Mura PV and EGI project areas situated in flat-lying to dissected hilly terrain spanning the boundary between the Western and Northern Cape Provinces *c*. 45 km to the south-southwest of Loxton. The four Mura PV Solar project areas are labelled in white. Dark blue = EGI corridor. Access roads are outlined in orange and pale green with existing roads in white. The pale green polygon shows the boundary of the authorised Nuweveld WEF Cluster. Purple and red polygons broadly indicate areas of palaeontological heritage research interest previously identified by Almond (2020a). For the area outlined in red, however, recent fieldwork indicates that the palaeontologically sensitive beds crop out in higher-lying terrain to the west (slopes of Vaalkop) rather than in the eastern *vlaktes* traversed by the access road to Mura Solar 1 and 2 where bedrock exposure is generally poor.

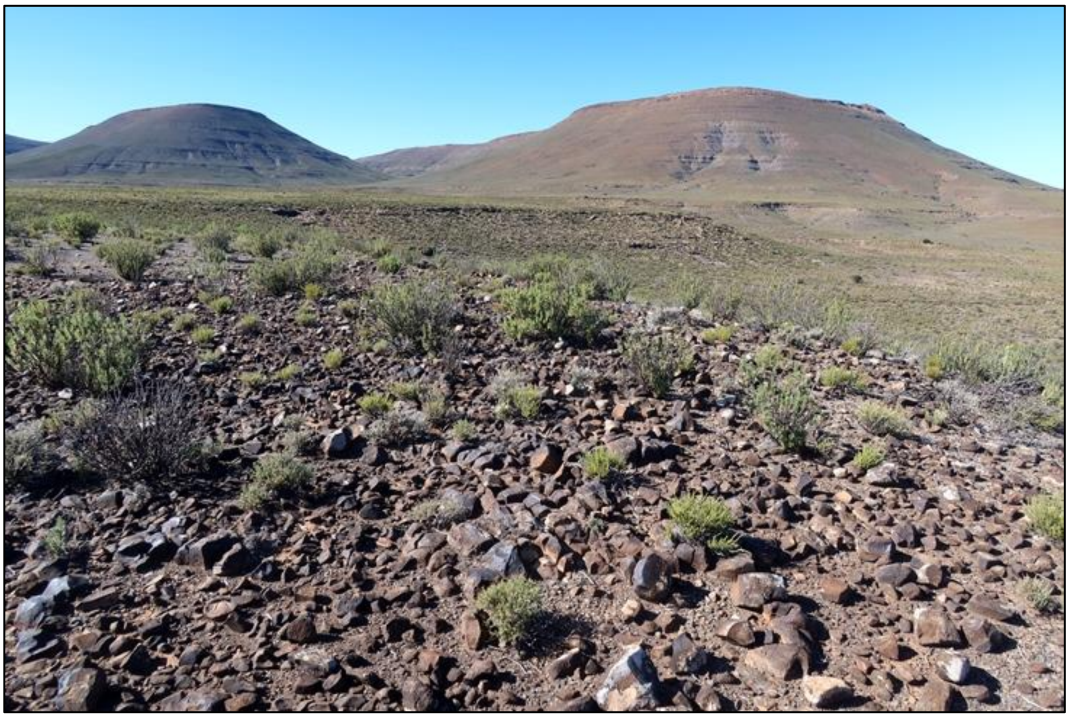

Figure 6: View eastwards towards Perdeberg on Sneeuw Kraal Farm 46. The extensive sandstone-capped plateau upon which the Mura PV Solar 3 and 4 project areas are situated (middle distance) lies close to the contact of the Poortjie Member *sensu lato* and the Hoedemaker Member of the Teekloof Formation.

Figure 7: *Vlaktes* mantled by sandy to gravelly soils and sparse *bossieveld* vegetation on Duiker Kranse Farm 3/45 with the dolerite-capped Perdeberg on the skyline to the east.

Figure 8: Sandy soils and eluvial (downwasted) gravels of brown-patinated quartzite are seen in open, pan-like areas (*brak kolle*) in flat-lying regions, as seen here on Duiker Kranse Farm 3/45.

Figure 9: Surface gravels dominated by brown-weathering, eluvial pedocrete concretions and small mudrock flakes seen within the Mura 3 project area on RE of Abrams Kraal Farm 206.

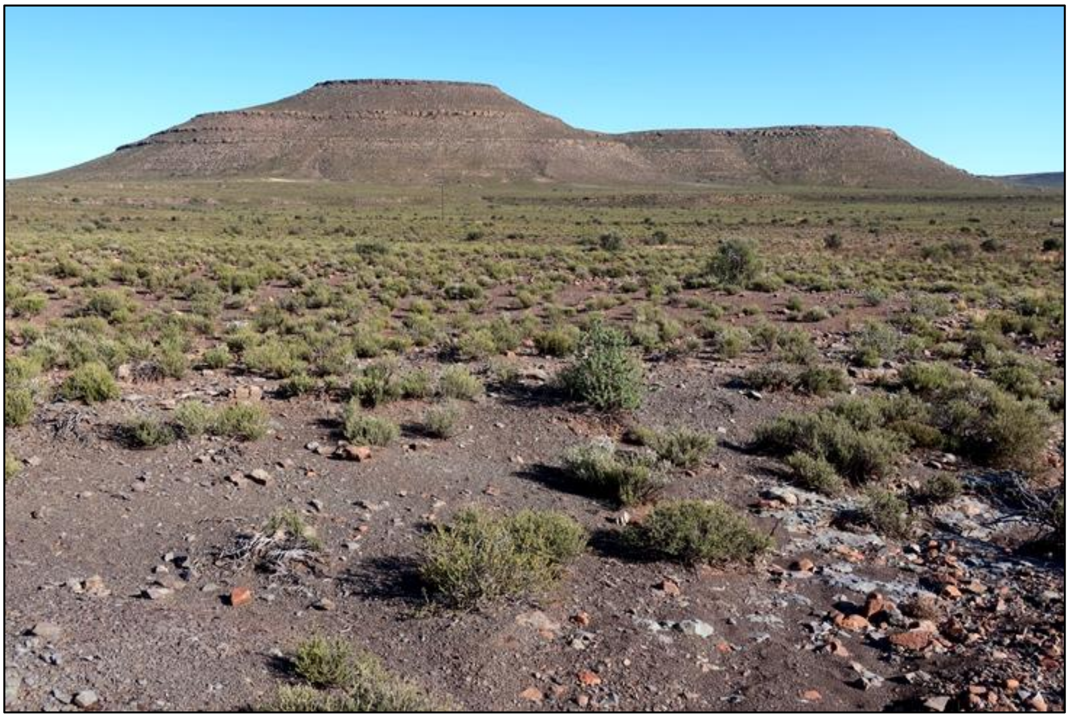

Figure 10: Vaalkop on Farm Leeuw Kloof 43, seen here from the east, is an important research area for the fossils and sediments of the Hoedemaker Member. The gullied mudrocks in the foreground have yielded only very sparse skulls of small dicynodonts.

Figure 11: View north-westwards towards Harpuisberg on Duiker Kranse 4/45 showing the flat-lying terrain mantled with angular, quartzitic eluvial gravels within the southern sectors of the Mura Solar 1 and 2 project areas.

Figure 12: View towards the ESE along the deeply-incised valley of the Kromrivier on the northern margins of Farm Duiker Kranse 3/45. Good exposures of the Poortjie Member underlying a regional land surface are seen in the steep valley walls (see below).

Figure 13: Good vertical sections through tabular-bedded sandstone and mudrock facies of the Poortjie Member along the Kromrivier Valley on Farm Sneeuw Kraal 46.

Figure 14: Excellent sections through the lower part of the Poortjie Member are seen in riverine cliffs at and (as here) just to the south of Duikerkrans on Farm Duiker Kranse 3/45.

Figure 15: Riverine cliff section through a package of thin-bedded, dark grey Poortjie Member mudrocks along the Kromrivier on Sneeuw Kraal 46.

Figure 16: Excellent – but only very sparsely fossiliferous – gullied exposures of purple-brown "red beds" within the upper Poortjie Member are seen on the north-eastern margins of the Mura Solar 3 project area on RE of Abrams Kraal Farm 206.

Figure 17: Gullied purple-brown and grey-green mudrocks of the upper Poortjie Member on Aangresend Abrams Kraal Farm 11, just west of the Mura Solar 4 project area (and within the EGI corridor).

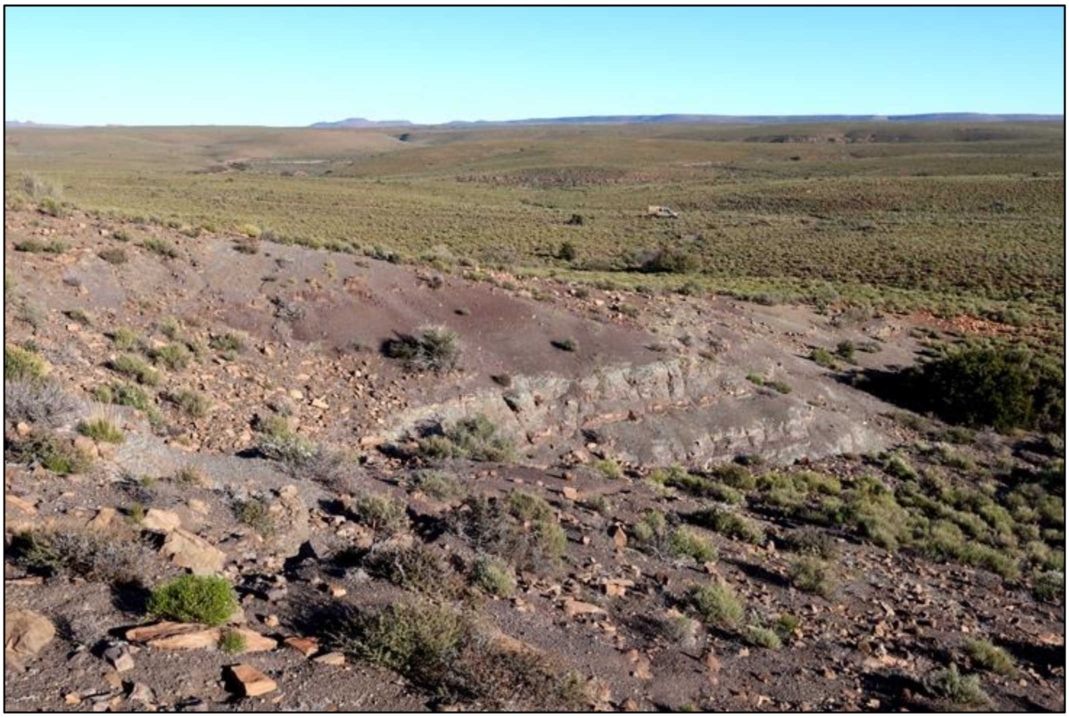

Figure 18: Good gullied exposures of upper Poortjie Member purple-brown mudrocks in the western foothills of Perdeberg on Farm Sneeuw Kraal 46.

Figure 19: Good sections through the Hoedemaker Member, dominated by purple-brown mudrock packages with subordinate, prominent-weathering, thin crevasse-splay or channel sandstones are seen on the western slopes of Perdeberg on Sneeuw Kraal 46. The desert-varnished boulder in the foreground has been downwasted from the dolerite sill capping the *koppie* behind.

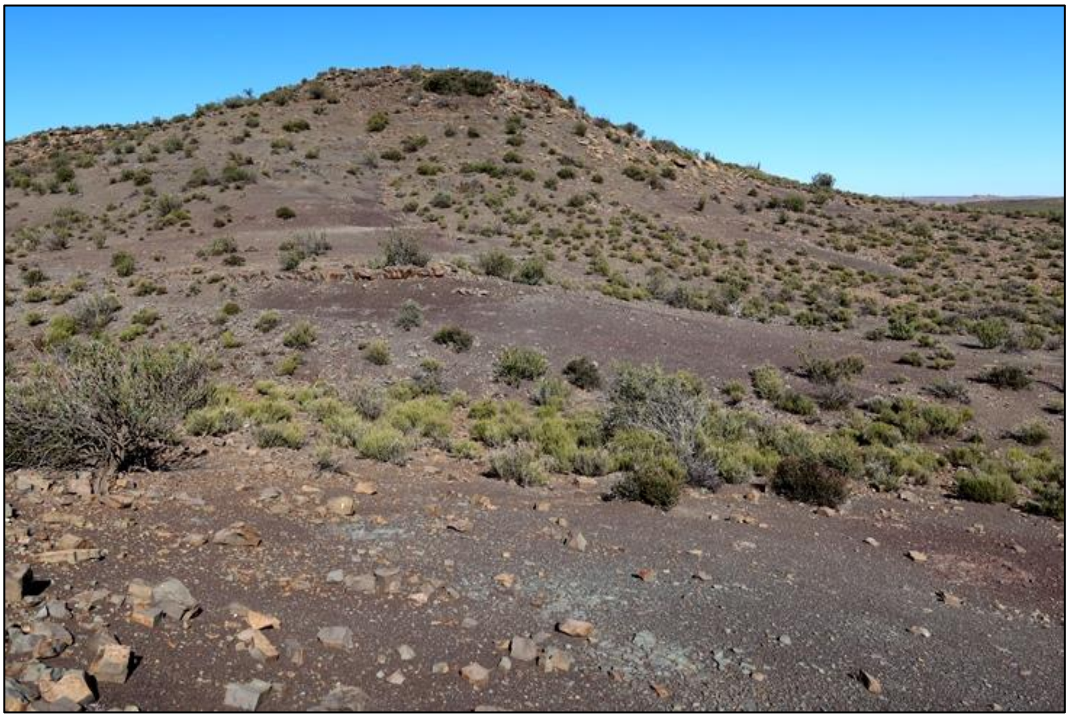

Figure 20: Gentle hillslope exposures of purple-brown Hoedemaker Member mudrocks with abundant pedogenic concretion horizons, as seen here on Duiker Kranse 3/45, are ideal for palaeontological recording.

Figure 21: Lens of calcrete-rich breccio-conglomerate towards the base of a channel sandstone of the Hoedemaker Member on Duiker Kranse 3/45 (hammer = 30 cm). This facies may contain small fragments of reworked tetrapod bones and (more rarely) teeth (See Section 4).

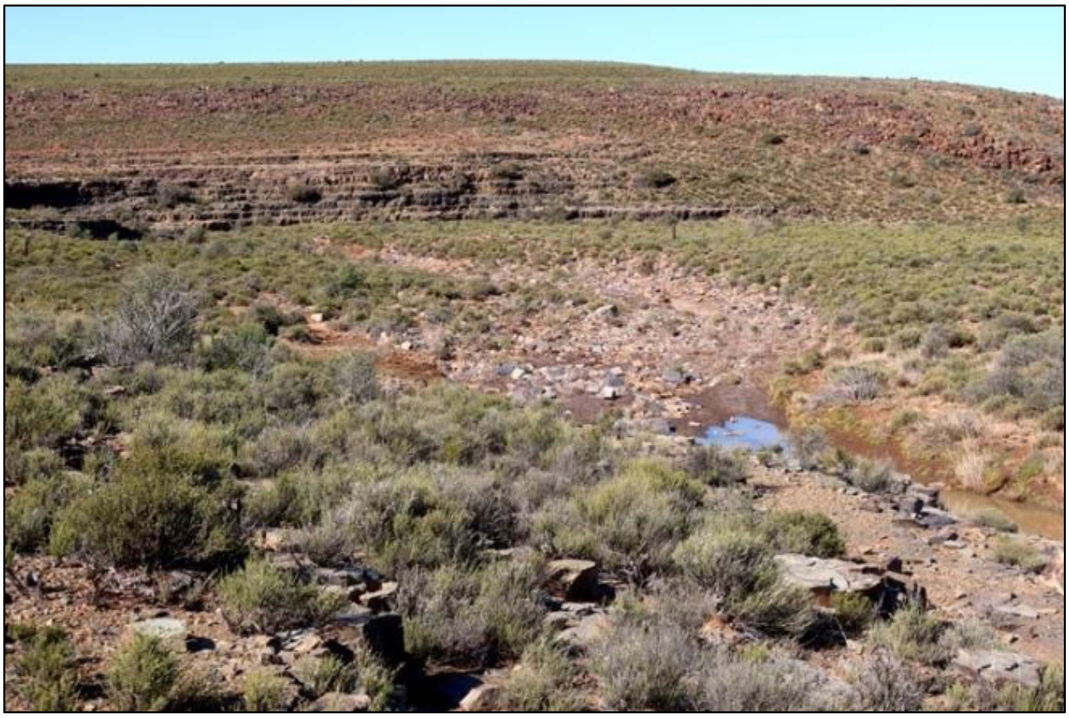

Figure 22: Rusty-brown dolerite sill overlying tabular-bedded Hoedemaker Member beds on Duiker Kranse 4/45, just east of the Mura Solar 1 project area. The sedimentary bedrocks here have been extensively metamorphosed due to heating and the influence of hydrothermal (hot, mineralising) fluids during dolerite intrusion.

Figure 23: Closer view of the riverine cliff of baked Hoedemaker Member mudrocks (dark hornfels) and wackes (pale metaquartzites) seen in the previous illustration. Thermal and chemical alteration has compromised fossil preservation within the metamorphic aureole of the overlying dolerite intrusion.

Figure 24: Horizon of pale, leached pedogenic calcrete concretions as typically found within highly baked Beaufort Group mudrocks, seen here Sneeuw Kraal Farm 6 (hammer = 30 cm). Any skeletal material originally preserved within such concretions is likely to have been dissolved away.

Figure 25: Ruiniform landscape of blocky-jointed, karstified dolerite within the EGI corridor on Bultfontein Farm 13. Such areas are entirely unfossilferous.

Figure 26: Relict prism of well-consolidated, calcretised, gritty to coarsely-gravelly diamictite of flood (inundite) or debris flow (debrite) origin overlying flaggy-bedded Poortjie Member channel wackes exposed along a river channel on Duiker Kranse 4/45.

Figure 27: Riverine cliff section through brownish sandy younger alluvium underlain by more consolidated, partially calcretised, orange-hued sandy to gravelly older alluvium exposed along the Kromrivier on Sneeuw Kraal Farm 6.

4. PALAEONTOLOGICAL HERITAGE

The continental (fluvial / lacustrine) sediments of the Poortjie Member and Hoedemaker Member of the Teekloof Formation that are mapped within the Mura PV Solar and EGI project areas are associated with important fossil assemblages of latest Middle Permian to earliest Late Permian age. According the latest biostratigraphic zonation of the Main Karoo Basin by Smith *et al*. (2020) these assemblages are assigned to the ***Endothiodon*** **Assemblage Zone** (AZ) within the upper part of the Poortjie Member as well as most, if not all, of the Hoedemaker Member (Day & Smith 2020) (See biostratigraphic chart in Figure 28. *N.B.* It remains uncertain whether or not older fossil assemblages of the *Tapinocephalus* Assemblage Zone are represented here within the lower part of the Poortjie Member - see discussion below). The *Endothiodon* AZ fossil assemblages include a wide range of vertebrates (bony fish, temnospondyl amphibians, true reptiles, several therapsid subgroups – especially dicynodonts), non-marine molluscs, invertebrate and vertebrate trace fossils (including tetrapod trackways and burrows) as well as petrified wood, palynomorphs and other plant remains of the *Glossopteris* Flora. The fossils are variously associated with channel sandstones (including basal breccio-conglomerates) as well as crevasse splay sandstones (*e.g.* rippled palaeosurfaces) and - especially - overbank mudrock facies with calcretised palaeosol horizons. They have been reviewed in the publications listed above as well as by Smith *et al.* (2012), supplemented by recent PIA reports by the present author for the Red Cap Nuweveld and Hoogland WEFs and grid connections (See References).

Lower *Endothiodon* AZ (*Lycosuchus – Eunotosaurus* Subzone) assemblages are associated with the upper Poortjie Member beds while the *Tropidostoma – Gorgonops* Subzone is represented within the overlying Hoedemaker Member. The Reiersvlei Meanderbelt transition zone has yielded good material of *Endothiodon* low down (Maharaj *et al.* 2019) (Figure 31) and probably belongs, at least in part, within the lower part of the *Endothiodon* AZ where this genus of sizeable dicynodont tends to be most abundant.

Mapping of Beaufort Group vertebrate fossil sites by Nicolas (2007) (Figure 29) shows a high concentration of fossil sites to the SE of Loxton reflecting, in part, fieldwork by the Council for Geoscience in the Booiskraal – Perdeberg area (Dr Colin MacRae, late 1900s) as well as the long history of palaeontological recording by Professor R. Smith from the Hoedemaker Member at sites like Dunedin (Quaggafontein 82) and Leeukloof 43 (*cf* Smith 1993). Historical fossil sites are not indicated within the present project area on the 1: 250 000 Victoria West geology sheet, apart from a single *Pristerognathus* AZ site (now *Endothiodon* AZ) from the Poortjie Member to the SW of Perdeberg (small black triangle indicated by yellow arrow on map Figure 4).

A key skull specimen of the large therocephalian *Pristerognathus* studied by J. van den Heever (1987) was collected from the Poortjie Member on the lower slopes of Perdeberg (R. Smith, pers, comm., 2022). Rich assemblages of small dicynodonts (especially *Diictodon*) within the Hoedemaker Member on the Farm Leeukloof 43, within the Nuweveld East Wind Farm project area just west of the present project area, are the subject of on-going benchmark taphonomic studies on Beaufort Group tetrapods by Dr Smith of Wits University (*e.g.* Smith 1993). A few additional sites with skulls and postcrania of small- to large-bodied dicynodonts, including *Diictodon* and probable *Endothiodon*, tetrapod burrow casts, plant stem casts and invertebrate trace fossil assemblages have been recorded from the Hoedmaker Member beds close to or within the western end of the Gamma Gridline Corridor during recent PIAs for the Red Cap Nuweveld East Wind Farm and Grid Connection (Almond 2020a, 2020b, 2022c).

Fossil material recorded during the recent site visit to the combined Mura PV Solar and EGI project areas is tabulated in Appendix 1, together with GPS locality data, a provisional Field Rating and any recommended mitigation. Selected examples of representative fossils are illustrated below in Figures 32 to 54 while the fossil sites are plotted on satellite maps in relation to the development footprints in Figures A1.1 and A1.2 in Appendix 1.

The main fossil groups recorded from the upper Poortjie Member – lower Hoedemaker Member beds within the Mura project and EGI areas include:

- Several skulls and partially-articulated postcrania of small-bodied dicynodonts, most or all of which are probably *Diictodon* (by far the commonest taxon within the stratigraphic units represented here);
- Highly fragmentary, and mostly unidentifiable, reworked bones within channel breccia lenses;
- Rare isolated bones (mostly fragmentary) of medium- to large tetrapods whose identity is currently equivocal; options include dinocephalian or therocephalian therapsids, pareiasaur parareptiles or large-bodied dicynodonts such as *Endothiodon* (see further discussion below);
- Straight, inclined to helical (or combined) tetrapod burrow casts;
- Low-diversity invertebrate trace fossil assemblages (*Scoyenia* Ichnofacies), often associated with wave-rippled surfaces and microbial mat textures (microbially-induced sedimentary structures or MISS) associated with damp or wet depositional settings. These may occasionally occur with possible (but unconfirmed) temnospondyl amphibian finger probes.
- Rare occurrences of carbonaceous plant stem or leaf compressions within both mudrock and sandstone facies as well as reedy plant stem casts in sandstones.

In general, fossils are very sparsely distributed within both the Poortjie Member and Hoedemaker Member outcrops within the present project areas and the great majority of the material is of modest scientific or conservation value. No fossils have been recorded within the Late Caenozoic superficial sediments here. Recorded Lower Beaufort Group fossil sites are mainly concentrated in scattered areas of good mudrock exposure which are mostly found along major drainage lines and on gullied hillslopes. The PV solar project areas are generally flat with very low levels of bedrock exposure due to the pervasive blanket of superficial deposits (eluvial gravels, soils) found here. No fossil sites are recorded within the Mura Solar 1, 2 and 4 project areas. Several fragmentary vertebrate fossils have been recorded within stream-gullied terrain on the margins of the Mura Solar 3 project area (Appendix 1, Figure A1.2). Such areas are unlikely to form part of the final development, however, and the scientifically valuable material has already been collected for incorporation into the palaeontological collections of the Evolutionary Studies Institute, Wits University.

Of potential palaeontological research interest is the concentration of robust, pale brown bone blocks recorded from Loc. 083 (RE of Abrams Kraal Farm 206) within the Mura Solar 3 project area - and since collected - since these are likely to represent fragments of the highly pachyostosed (*i.e.* secondarily thickened) cranium of a head-butting tapinocephalid dinocephalian (Prof. Bruce Rubidge, Wits University, pers. comm., 2022) (*cf* Figures 45 to 48). The numerous bone blocks have probably weathered out of a thin channel sandstone body (*e.g.* basal breccia lens) which crops out just upslope. The distinctive bone histology - with a smooth outer surface, fibrous outer zone with occasional wider radial canals and a spongy inner zone - is well seen in tapinocephalid cranial remains recently recorded from the *Tapinocephalus* AZ near Aberdeen (Almond 2022d) as well as on the lateral skull margins of the dinocephalian *Criocephalosaurus* from the lower Poortjie Member south of Beaufort West (Almond 2021c).

Tapinocephalid dinocephalians are an essentially Middle Permian group of therapsid megaherbivores that have only been recorded hitherto as high up as the lower Poortjie Member within the Lower Beaufort succession (Day *et al.* 2015a, 2015b, Day & Rubidge 2020). The fragmentary new Abrams Kraal 206 fossil material is recorded at an elevation of *c*.1440 m amsl. which probably corresponds to the *upper* part of the Poortjie Member (at least as mapped by the Council for Geoscience) on the western and southern slopes of Perdeberg (Figure 47). This assumes that the Teekloof Formation beds around Perdeberg are more-or-less flat-lying, as appears to be the case in the field, and there are no intervening major dolerite intrusions or faults influencing bedrock elevation. The Poortjie Member *sensu lato* succession on the western slopes of Perdeberg near Booiskraal homestead (Figures 2 & 3) is *at least* 130 m thick (*c.*1360-1390m amsl.) (*cf* Le Roux & Keyser 1988 who record Poortjie Member thicknesses on sheet 3122 Victoria West of 130 m in the west thinning to *c*. 80m in the east). The upper Poortjie Member elsewhere is characterised by faunas of the lower *Endothiodon* Assemblage Zone (*Lycosuchus – Eunotosaurus* Subzone) which extends into the earliest Late Permian and is not known to include dinocephalians (Day & Smith 2020). Further fieldwork is required to determine whether the purported Abrams Kraal 206 tapinocephalid can be confidently assigned to the upper Poortjie Member (or even higher interval) and if any other fossils of biozonal significance (*e.g. Endothiodon*) co-occur at this stratigraphic level.

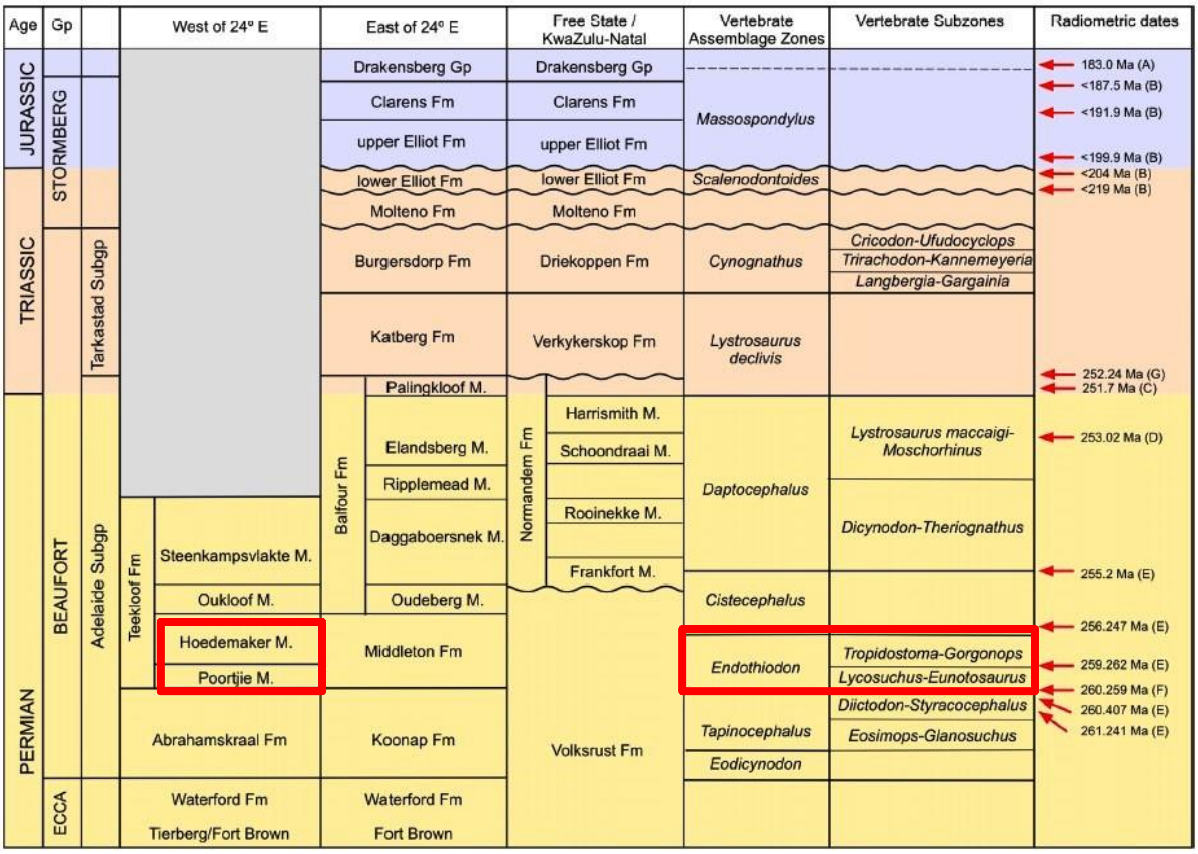

Figure 28: Chart showing the latest, revised fossil biozonation of the Lower Beaufort Group of the Main Karoo Basin (abstracted from Smith *et al.* 2020). Rock units and fossil assemblage zones mapped or inferred within the Mura PV Solar and EGI project areas are outlined in red respectively. However, the detailed mapping of these lithostratigraphic and biostratigraphic units within the present project area is unresolved at present (see text for discussion). Fragmentary skull remains of a probable tapinocephalid dinocephalian recorded on Farm Abrahamskraal 206 *may* indicate the presence here of upper *Tapinocephalus* Assemblage Zone biotas within the lower Poortjie Member. Alternatively, they might suggest the persistence of tapinocephalid dinocephalians into the latest Middle Permian or even earliest Late Permian *Endothiodon* Assemblage Zone within the upper Poortjie Member.

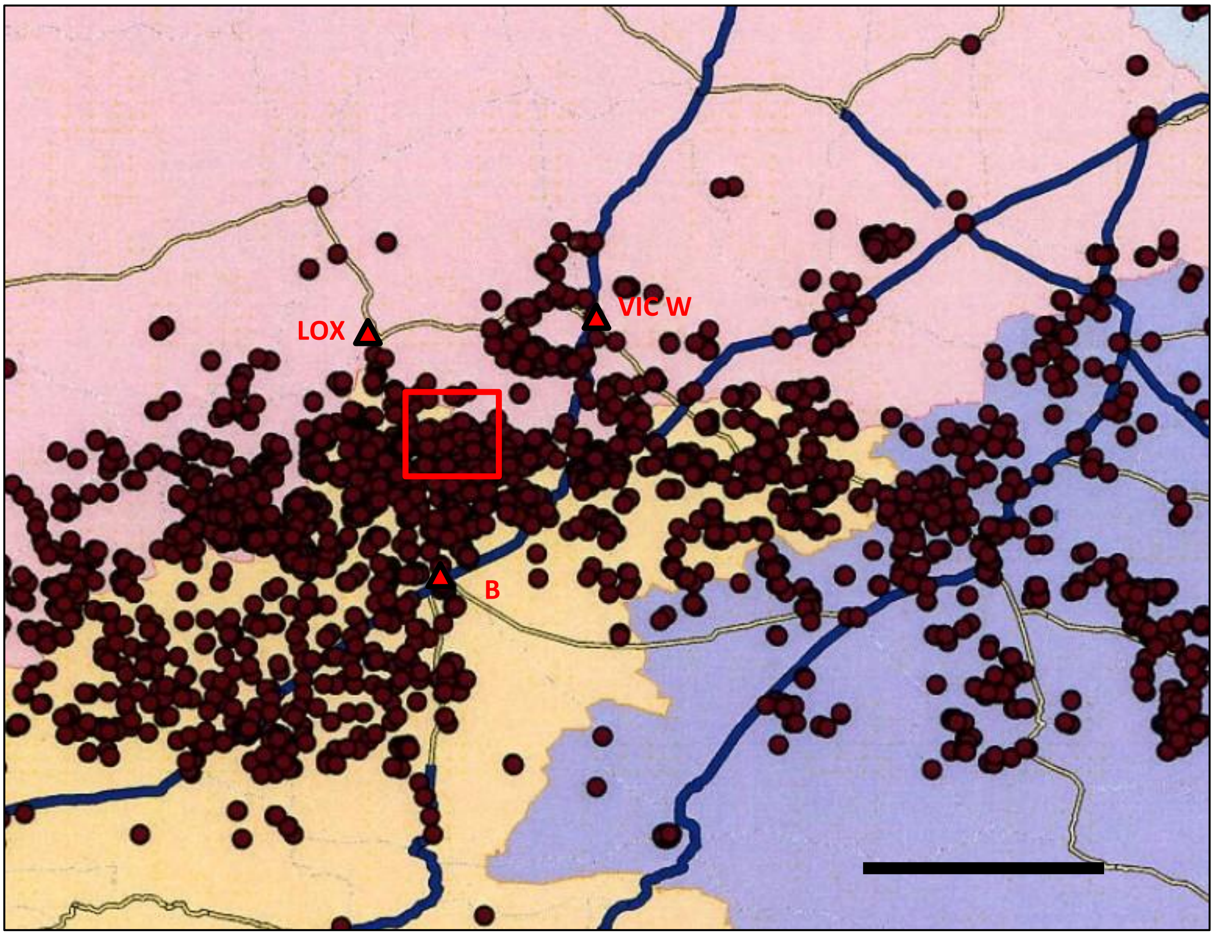

Figure 29: Distribution map of recorded vertebrate fossil sites within the Lower Beaufort Group of the Great Karoo between Loxton (LOX), Victoria West (VIC W) and Beaufort West (BW), showing *very approximately* the location of the study area for the Mura PV Solar projects within the red rectangle (map abstracted from Nicolas 2007). North is towards the top of the image.

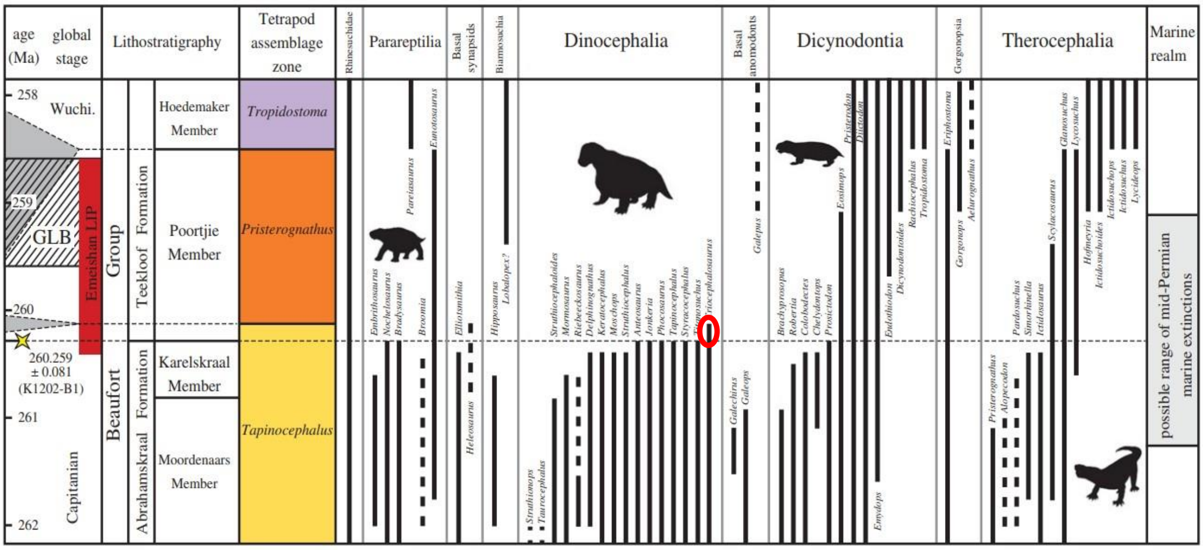

Figure 30: Chart showing the ranges of known terrestrial tetrapod genera from the Middle to Late Permian of the Main Karoo Basin (From Day *et al.* 2015b). The boundary between the Abrahamskraal and Teekloof Formations is associated with a catastrophic extinction event at the end of the Middle Permian / Capitanian Stage (c. 259.5 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 on the left of the figure). 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. A few genera of dinocephalians have recently been recorded from the lower part of the Poortjie Member of late Middle Permian age. IF the fragmentary tapinocephalid skull remains from Farm Abrahamskraal 206 recorded herein do, in fact, lie within the upper rather than lower Poortjie Member (currently unconfirmed), this would suggest that this important group of megaherbivores survived right until the Middle / Late Permian boundary, or even just beyond.

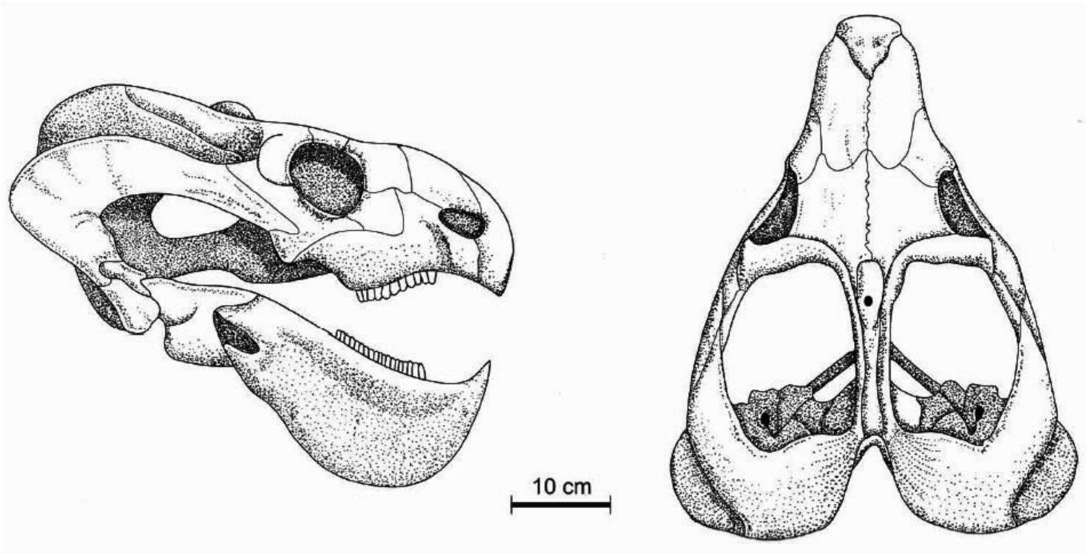

Figure 31: Skull of the medium-sized dicynodont therapsid *Endothiodon* which occurs especially abundantly within the lower part of the *Endothiodon* Assemblage Zone, following the late Middle Permian Mass Extinction Event. Some of the more robust skeletal remains from the upper Poortjie Member and Hoedemaker Member in the study region are likely to belong to this taxon.

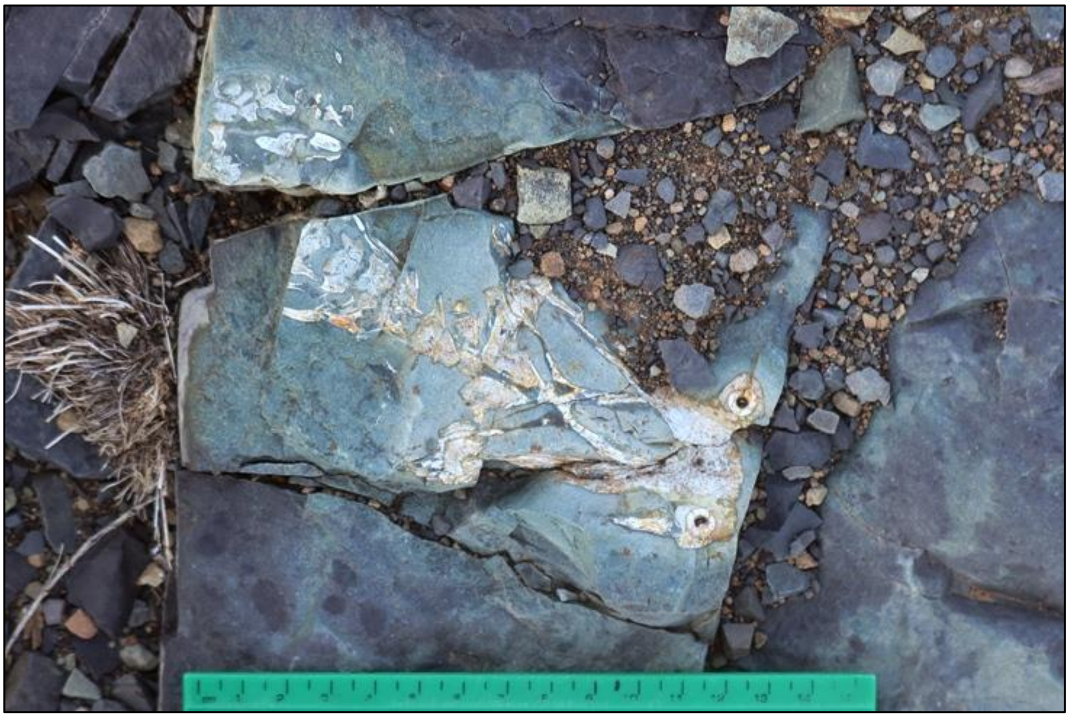

Figure 32: Horizontal section through the articulated skull and anterior postcrania of a small dicynodont (probably *Diictodon*) within Hoedemaker Member mudrocks exposed in a stream bed on Leeuw Kloof Farm 43 (Loc. 095) (scale in cm). The site lies close to an access road footprint but is not regarded as of high scientific / conservation significance, given the local super-abundance of *Diictodon* within the Hoedemaker Member.

Figure 33: Section through the skull and semi-articulated anterior postcrania of a small dicynodont (probably *Diictodon*) within baked mudrocks of the Poortjie Member on Duiker Kranse Farm 3/45 (Loc. 052). The specimen as seen here is *c*. 12 cm across.

Figure 34: Articulated skull and lower jaw of a small dicynodont (probably *Diictodon*) preserved within a pedocrete concretion, Hoedemaker Member on Duiker Kranse Farm 3/45 (Loc. 127). Specimen is *c*. 7 cm long.

Figure 35: Poorly-preserved skull of a small dicynodont preserved within a pedocrete concretion, Poortjie Member on Sneeuw Kraal Farm 46 (Loc. 058). Scale in mm.

Figure 36: Fragmentary, disarticulated postcranial bones of a medium-sized tetrapod preserved within a mottled purple-grey wacke of the upper Poortjie Member on Sneeuw Kraal Farm 46 (Loc. 063). Scale in cm.

Figure 37: Probable vertebrate remains of a medium- to large-bodied tetrapod weathered out in float from the Hoedemaker Member on Duiker Kranse Farm 3/45 (Loc. 129). Scale in cm.

Figure 38: Isolated vertebra with short ribs preserved showing partial preservation as a mould within greyish to slightly purple-hued wacke of the upper Poortjie Member on RE of Abrams Kraal Farm 206 (Loc. 087). Scale in mm.

Figure 39: Lenticular basal channel breccio-conglomerate (arrowed) which has yielded fragmentary transported skeletal remains from the Poortjie Member on the RE of Abrams Kraal Farm 206 (Loc. 410) (See, for example, following figure).

Figure 40: Close-up of the channel basal breccia illustrated above showing one of several bone fragements preserved within this unit (Loc. 410). Scale in cm.

Figure 41: Downwasted block from a similar channel breccia facies illustrated in Figure 39 above from the Poortjie Member on the RE of Abrams Kraal Farm 206 (Loc. 399). Scale in mm.

Figure 42: Mudflake-rich channel breccia containing poorly-preserved bone fragment of a sizeable tetrapod, Poortjie Member on the RE of Abrams Kraal Farm 206 (Loc. 407). Specimen as seen here is 7 cm across.

Figure 43: Block of mudflake-rich channel breccia containing the mould of an unidentified bone (cranial or postcranial) of a medium- to large-bodied tetrapod, Poortjie Member on the RE of Abrams Kraal Farm 206 (Loc. 408). The specimen as seen here is *c*.12 cm across.

Figure 44: Float block of channel sandstone containing the mould of a transported bone (possibly rib) showing surface cracking, Poortjie Member on the RE of Abrams Kraal Farm 206 (Loc. 403). Scale in cm.

Figure 45: Several of the numerous small blocks of pale brown bone scattered at surface overlying the Poortjie Member on the RE of Abrams Kraal Farm 206 (Loc. 083). Scale is *c*. 15 cm long. The blocks show a distinctive parallel fibrous fabric, with occasional wider radial canals, towards the exterior and a spongy fabric towards the interior. They are provisionally interpreted as transported fragments of the pachyostosed (thickened) skull roof of a tapinocephalid dinocephalian (See Figure 48 below) which have weathered out from a thin channel sandstone shortly upslope.

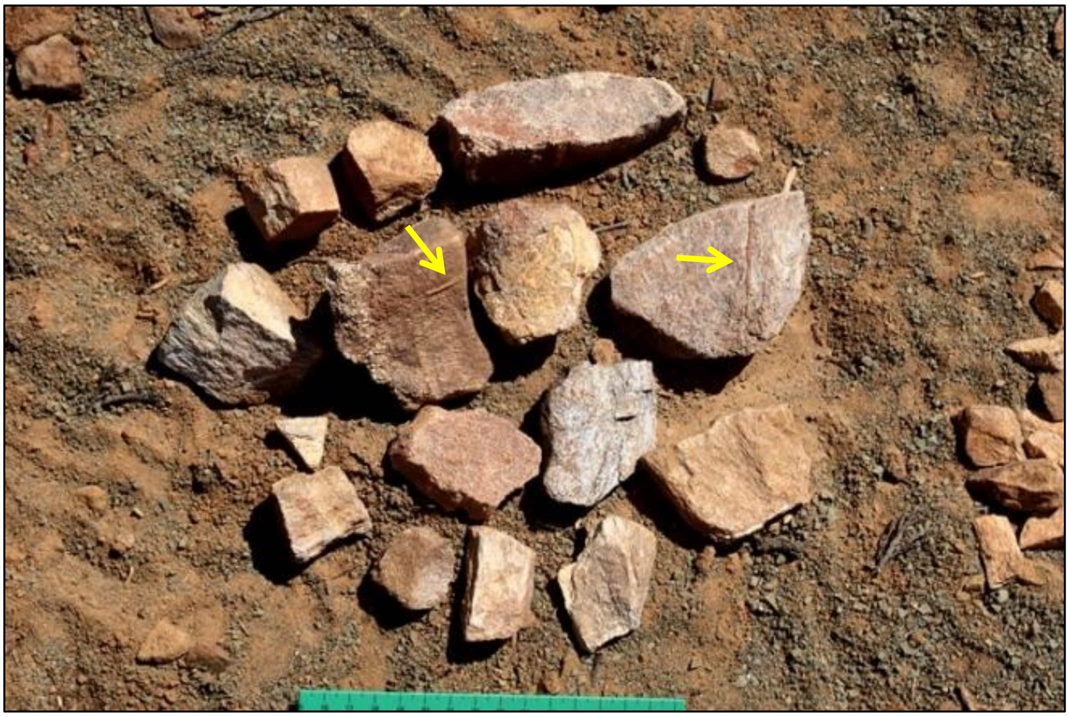

Figure 46: Additional float blocks of possible tapinocephalid affinity collected at Loc. 083 on the RE of Abrams Kraal Farm 206 (scale in cm). Blocks with radial canals are arrowed.

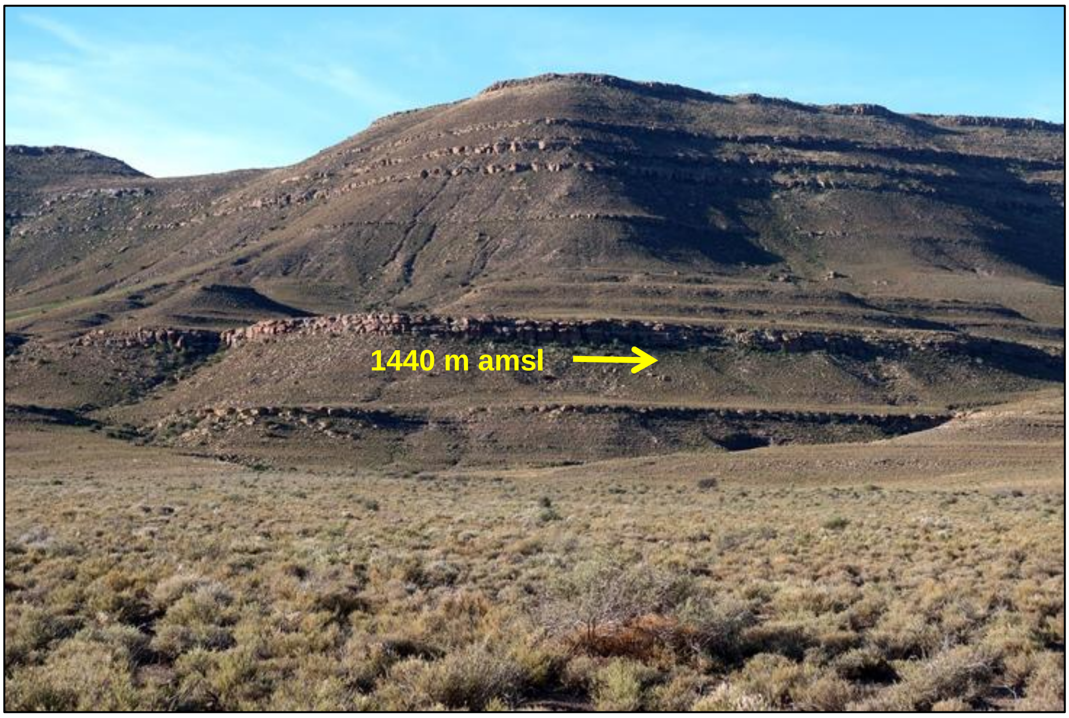

Figure 47: Teekloof Formation succession on the southern face of Perdeberg, some 8 km SSE of the tapinocephalid cranial material site illustrated above which was recorded at *c*. 1440 m amsl. Assuming that the Teekloof Formation beds are approximately flat-lying in the Perdeberg region, with no intervening major faults or dolerite intrusions, the fossil horizon is inferred to lie *towards the top* of the Poortjie Member *sensu lato* (as mapped by the CGS). These beds that are elsewhere assigned to the lower part of the *Endothiodon* Assemblage Zone and may even be earliest Late Permian in age.

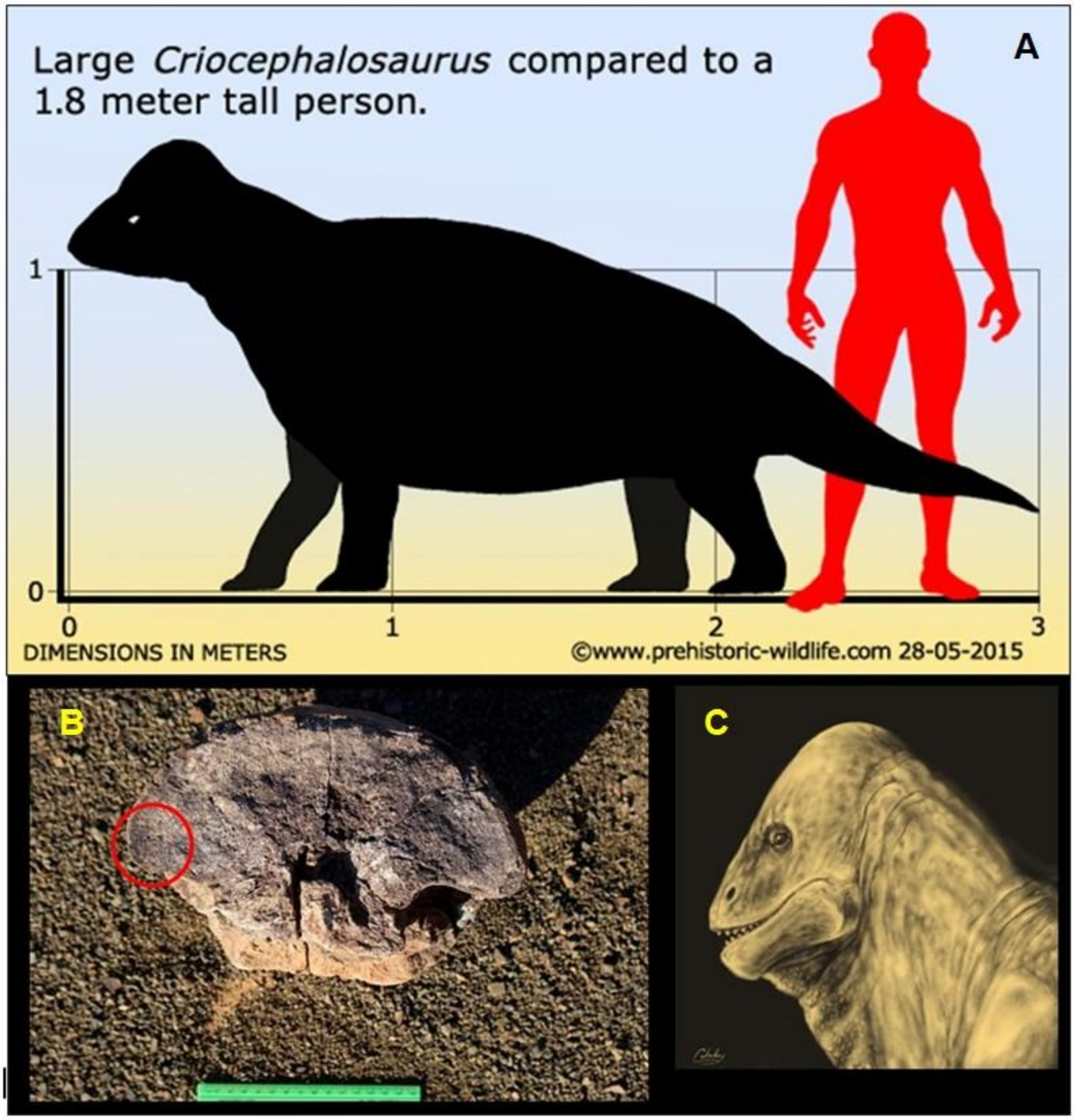

Figure 48: (A, C) Artists' reconstructions of the ill-favoured, dome-headed tapinocephalid dinocephalian *Criocephalosaurus* (from Internet) – one of the last surviving members of this important subgroup of therapsid herbivores, several examples of which have been recorded recently from the lower Poortjie Member near Beaufort West. (B) Transverse vertical section through the greatly thickened (pachyostosed) skull roof of *Criocephalosaurus* (*cf* Almond 2021c. Scale = 15 cm). The lateral margins of the skull roof (red ellipse) show a radially fibrous fabric with occasional canals comparable to that seen in Figures 45 and 46 above. Similar bone textures are also seen in fragments of tapinocephalid skull roof recently recorded in the Aberdeen area (Almond 2022d).

Figure 49: Cast of a small, inclined tetrapod burrow with smooth, bioturbated floor within baked mudrocks and wackes of the Poortjie Member exposed in a stream bed on Duiker Kranse Farm 3/45 (Loc. 053). Hammer = *c.* 30 cm.

Figure 50: Baked, greenish-grey cast of a small tetrapod burrow preserved within purple-brown overbank mudrocks of the Hoedemaker Member on Leeuw Kloof Farm 43 (Loc. 094). Scale = *c.* 15 cm. The burrow shows a helical configuration on the left with a subhorizontal, linear section extending to the right.

Figure 51: Sandstone sole surface with scattered small invertebrate burrows as well as possible larger digital prods of temnospondyl amphibians (arrowed), Poortjie Member on Duiker Kranse Farm 3/45 (Loc. 121). Scale is *c*. 15 cm long.

Figure 52: Wave-rippled sole surface of a Poortjie Member sandstone float block showing backfilled invertebrate burrows of the damp substrate *Scoyenia* Ichnofacies, Sneeuw Kraal Farm 46 (Loc. 034). Scale in cm.

Figure 53: Broad, strap-like, longitudinally-striated, carbonaceous compression of a fossil plant preserved within channel wackes of the upper Poortjie Member on Sneeuw Kraal 46 (Loc. 444). Scale in cm.

Figure 54: Poorly preserved compression of a plant axis (probably a sphenophyte stem) preserved within purple-brown overbank mudrocks of the Hoedemaker Member on Leeuw Kloof Farm 43 (Loc. 098). Scale = *c*. 15 cm.

5. SITE SENSITIVITY VERIFICATION

Provisional site sensitivity mapping for palaeontological heritage using the DFFE National Web-Based Environmental Screening Tool (as well as the SAHRIS Palaeosensitivity Map) suggests that the majority of the 4 Mura Solar project areas (including access roads) as well as the Mura EGI project area is of High to Very High Palaeosensitivity (Figures 55 to 61). Small sectors of the project areas that are underlain by substantial alluvial deposits along major drainage lines are assigned a Medium Palaeosensitivity while areas underlain by dolerite intrusions are palaeontologically Insensitive.

A **Low Palaeosensitivity** for all these project areas (Mura Solar 1-4, access roads and EGI) is inferred in this report on the basis of:

- Desktop analysis of relevant geological maps and palaeontological databases, including previous PIA studies in the region by the author (*e.g.* Nuweveld WEF cluster and Grid Connection);
- A six-day palaeontological heritage site visit to the combined Mura project area which yielded only a very sparse scatter of fossil sites (mostly of low scientific / conservation value) within the Lower Beaufort Group bedrocks and no Late Caenozoic sites;
- Generally low to very low levels of bedrock exposure, especially within the low-relief Mura Solar 1-4 project areas. Most fossil sites occur in gullied hillslopes and along major drainage lines which form only a very minor part of the combined project area;
- Dolerite intrusions which have compromised fossil preservation in some sectors of the combined project area.

The DFFE-based palaeosensitivity mapping is accordingly *contested* here.

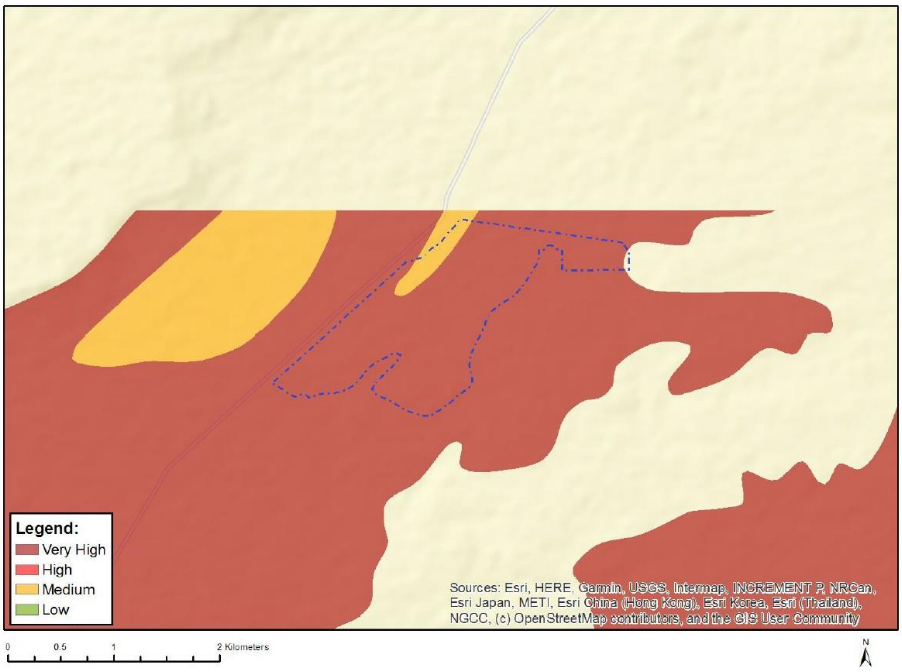

Figure 55: Palaeontological sensitivity map for the Mura Solar 1 project area (blue dotted polygon), abstracted from the DFFE Screening Report prepared by Red Cap (September 2022). Most of project area is designated Very High Sensitivity here with the exception of areas mantled by alluvium of Medium Sensitivity. This provisional sensitivity mapping is *contested* in this report which concludes that the entire project area is in fact of LOW PALAEOSENSITIVITY.

Figure 56: Palaeontological sensitivity map for the Mura Solar 2 project area (blue dotted polygon) abstracted from the DFFE Screening Report prepared by Red Cap (September 2022). Much of project area is designated Very High Sensitivity here with the exception of areas mantled by alluvium of Medium Sensitivity. This provisional sensitivity mapping is *contested* in this report which concludes that the entire project area is in fact of LOW PALAEOSENSITIVITY.

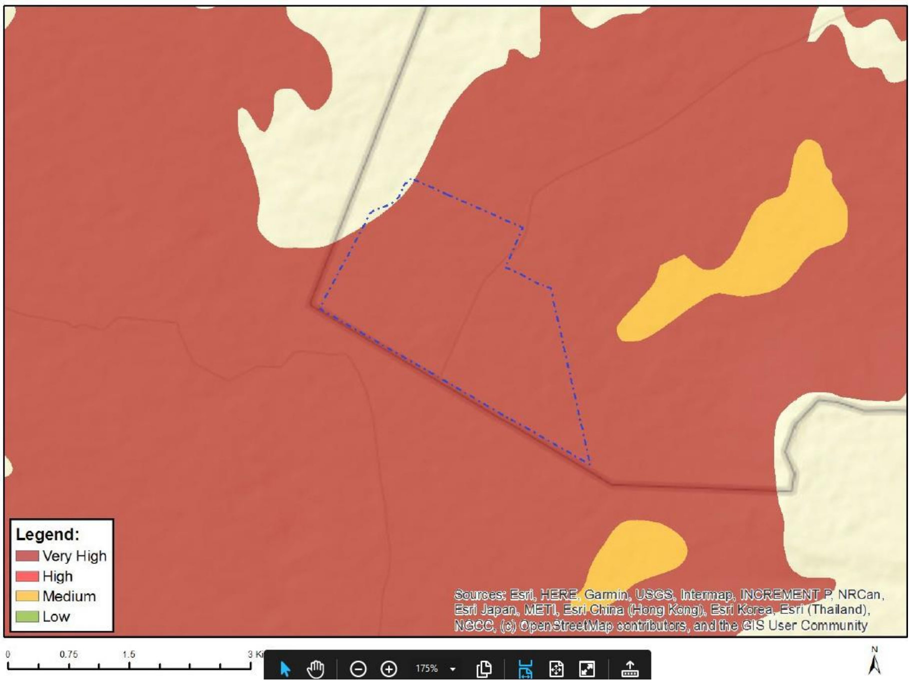

Figure 57: Palaeontological sensitivity map for the Mura PV 3 project area (blue dotted polygon) abstracted from the DFFE Screening Report prepared by Red Cap (September 2022). Almost all of the project area is designated Very High Sensitivity here. This provisional sensitivity mapping is *contested* in this report which concludes that the entire project area is in fact of LOW PALAEOSENSITIVITY.

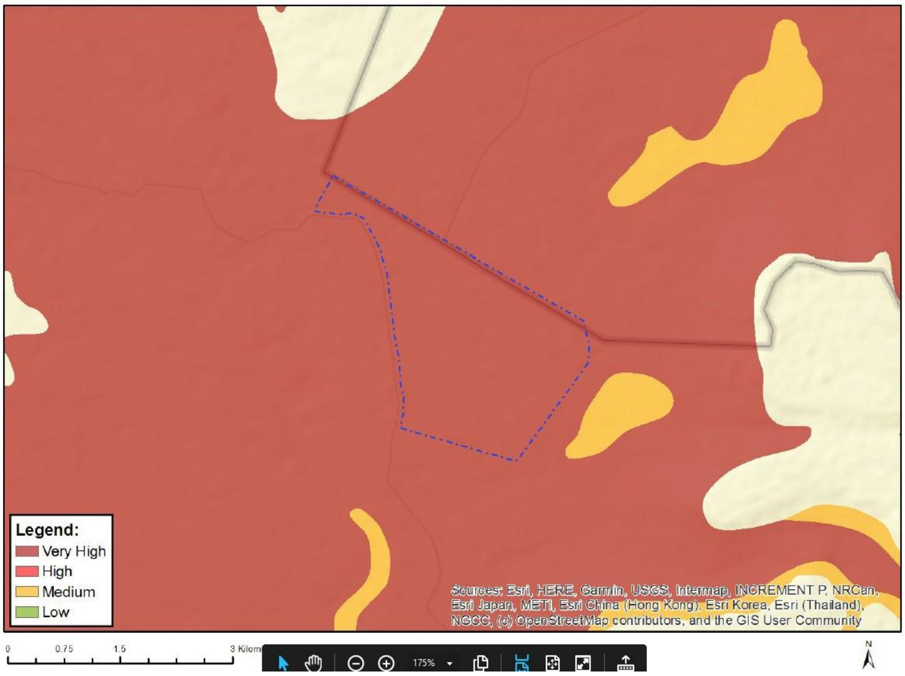

Figure 58: Palaeontological sensitivity map for the Mura PV 4 project area (blue dotted polygon), abstracted from the DFFE Screening Report prepared by Red Cap (November 2022). All of the project area is designated Very High Sensitivity here. This provisional sensitivity mapping is *contested* in this report which concludes that the entire project area is in fact of LOW PALAEOSENSITIVITY.

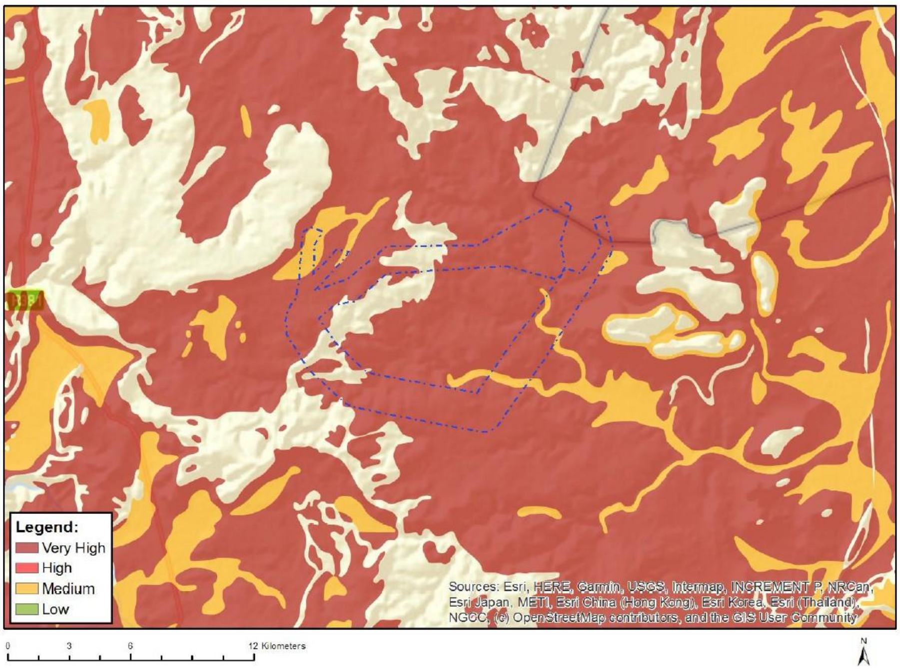

Figure 59: Palaeontological sensitivity map for the Mura EGI project area (blue dotted polygon), abstracted from the DFFE Screening Report prepared by Red Cap (September 2022). Most of the project area is designated Very High Sensitivity here with the exception of minor zones of Medium Sensitivity (alluvium) and Zero Sensitivity (dolerite intrusions). This provisional sensitivity mapping is *contested* in this report which concludes that the entire project area, apart from the insensitive dolerite intrusions, is in fact of LOW PALAEOSENSITIVITY.

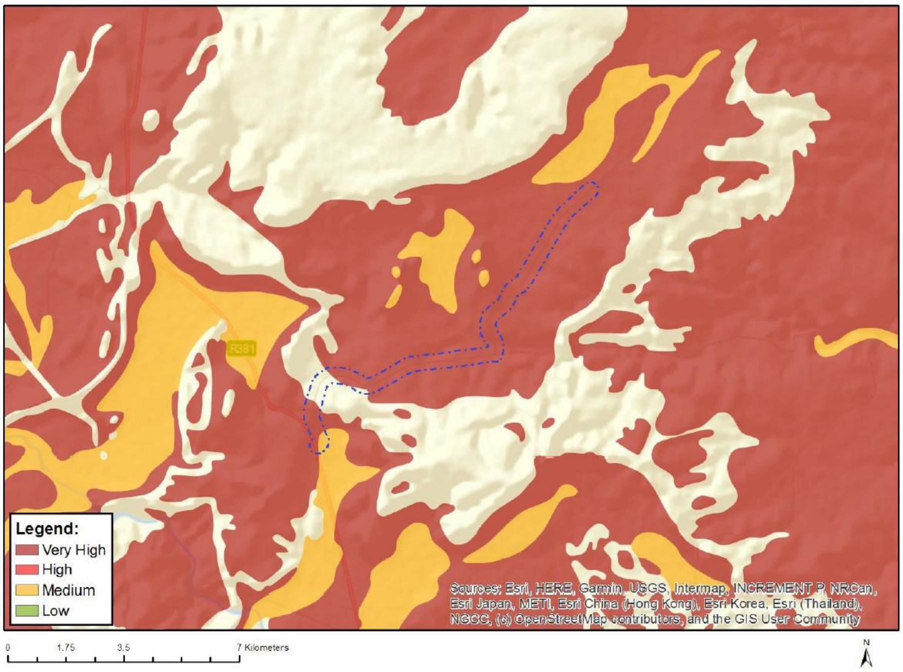

Figure 60: Palaeontological sensitivity map for the Mura 1 and 2 access road project area (blue dotted polygon), abstracted from the DFFE Screening Report prepared by Red Cap (September 2022). Most of the project area is designated Very High Sensitivity here with the exception of minor zones of Medium Sensitivity (alluvium) and Zero Sensitivity (dolerite intrusions). This provisional sensitivity mapping is *contested* in this report which concludes that the entire project area, apart from the insensitive dolerite intrusions, is in fact of LOW PALAEOSENSITIVITY.

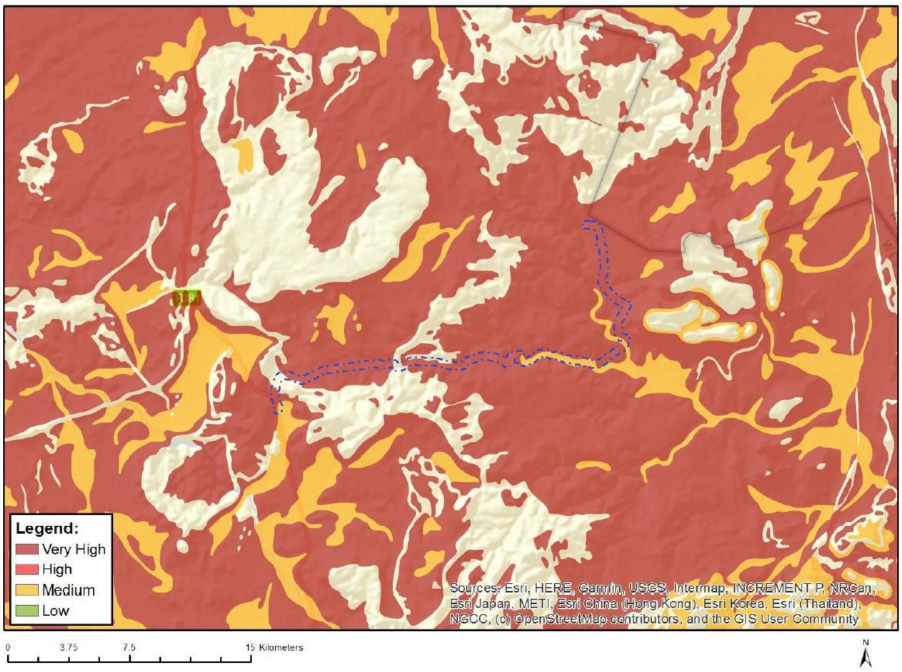

Figure 61: Palaeontological sensitivity map for the Mura 3 and 4 access road project area (blue dotted polygon), abstracted from the DFFE Screening Report prepared by Red Cap (September 2022). Most of the project area is designated Very High Sensitivity here with the exception of minor zones of Medium Sensitivity (alluvium) and Zero Sensitivity (dolerite intrusions). This provisional sensitivity mapping is *contested* in this report which concludes that the entire project area, apart from the insensitive dolerite intrusions, is in fact of LOW PALAEOSENSITIVITY.

6. IMPACT ASSESSMENT

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed projects, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considers direct, indirect, secondary as well as cumulative impacts (Figure 62).

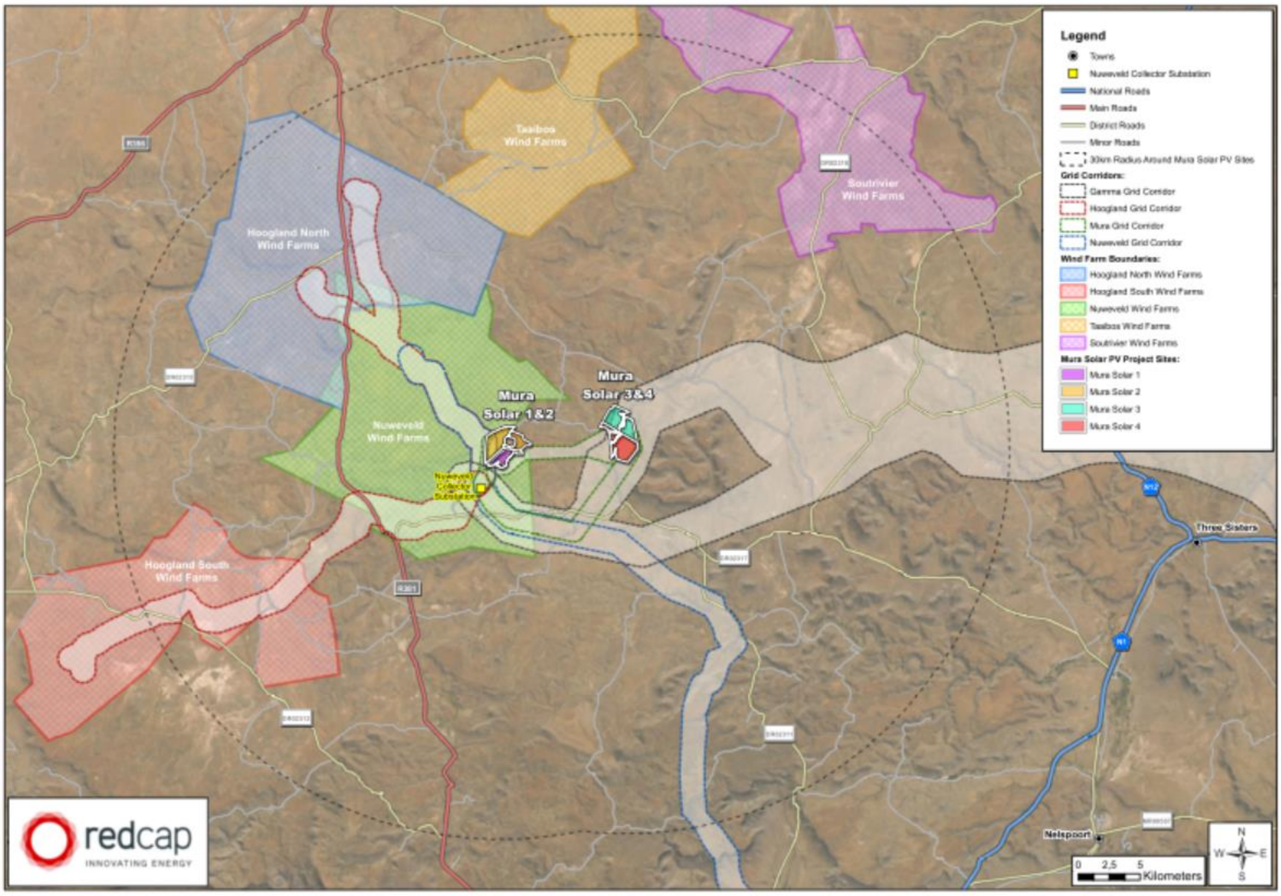

Figure 62: Cumulative Assessment of projects withing 30km of the Mura PV Development

A standard risk assessment methodology provided by WSP was used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact).

This assessment, as summarized in Table 1, considers potential impacts fossil heritage resources within the project footprints that are of scientific and conservation value. The anticipated impact significance is assessed as Low without mitigation and Very Low following mitigation. If any substantial new fossil sites are revealed during the Construction Phase of the developments they should be handled using the Chance Fossil Finds Protocol appended to this report (Appendix 2). If no new fossils are found then no mitigation is required.

Once any new fossil finds have been collected there will be no significant further impacts on local palaeontological heritage. Therefore the impact assessment is only applicable to the construction phase. The operation and de-commissioning phases of the development will NOT impact the palaeontology.

Table 1: Construction impact on paleontological resources

Potential Impact: Loss of fossils	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**
Without Mitigation	2	1	5	5	2	26	Low	(-)
With Mitigation	2	1	5	5	1	13	Very low	(-)
Mitigation and Management Measures	Implement the Chance Fossil Find Protocol							

6. CONCLUSIONS

The four Mura PV Solar and associated EGI project areas are underlain by continental sediments of the Teekloof Formation (Poortjie and Hoedemaker Members) within the Lower Beaufort Group, Karoo Supergroup). Fossil assemblages of the *Endothiodon* Assemblage Zone of latest Middle to earliest Late Permian age are associated with the Lower Beaufort Group beds mapped within most or all of the combined project area; however, representatives of the older *Tapinocephalus* Assemblage Zone might also be present within the lower parts of the Poortjie Member (unconfirmed). These fossils record the recovery phase on land from the end-Middle Permian Mass Extinction Event of c. 260 million years ago.

A six-day palaeontological site visit, supported by desktop studies drawing on previous field-based palaeontological studies in the wider region, indicate that fossils of scientific and conservation significance – most notably well-preserved vertebrate remains – are very sparse indeed in this region (See data provided in Appendix 1). This is probably due, at least in part, to (1) the effects of the end-Middle Permian Mass Extinction Event, (2) the generally low to very low levels of sedimentary bedrock exposure, especially within the low-relief Mura PV Solar 1-4 project areas (most fossil sites occur in gullied hillslopes and along major drainage lines which form only a very minor part of the project areas) and (3) Early Jurassic dolerite intrusions which have compromised fossil preservation in some sectors of the project areas, including sectors of the western EGI corridors, through thermal metamorphism and associated hydrothermal processes (*e.g.* circulation of hot, mineralising ground waters). No fossil sites have been recorded within the Late Caenozoic superficial sediments (alluvium, colluvium *etc*).

It is concluded that the four Mura PV Solar and EGI project areas, including the footprints of all associated infrastructure (*e.g.* access road network) are, in practice, of LOW Palaeosensitivity, although the potential for unrecorded fossil sites of high scientific value cannot be entirely discounted. The provisional Medium to Very High Palaeosensitivity mapped by the DFFE Screening Tool is accordingly *contested* here.

Impacts on local palaeontological heritage resources due to the proposed solar and EGI developments are anticipated to be of Low significance before mitigation and Very Low significance following mitigation. Cumulative impacts are likely to be of Low to Very Low Significance in the context of other renewable energy developments proposed for the region (*viz*. Nuweveld WEF Cluster, Hoogland WEF Clusters, Soutrivier WEFs, Taaibos WEFs, Gamma Grid Line) and fall within acceptable limits. There are no objections on palaeontological heritage grounds to the authorisation of the proposed 4 Mura PV Solar developments or the associated EGI.

No recorded fossil sites of unique scientific or conservation value are likely to be directly impacted by the proposed renewable energy and electrical infrastructure developments and no further palaeontological studies or mitigation is proposed here with regard to these sites. **Pending the discovery of significant new fossil finds before or during construction, no further specialist palaeontological studies, monitoring or mitigation are recommended for these renewable energy and electrical infrastructure projects.** The Environmental Control Officer (ECO) responsible for the developments should be aware of the potential for fossil sites of scientific value and should monitor substantial surface clearance and excavations for fossils on an ongoing basis during the Construction Phase. Any new fossil sites revealed during the Construction Phase of the developments are best handled by the Chance Fossil Finds Protocol appended to this report (Appendix 2) which should be included within the EMPr for the developments.

Where Pre-construction or Construction Phase mitigation, comprising palaeontological recording and collection of fossil material and associated geological data, is triggered by chance fossil finds, this must be carried out by a suitably qualified palaeontological specialist under a Fossil Collection Permit (SAHRA) for Mura Solar 3 and the small portion of the EGI corridor located in the Northern Cape and an approved Work Plan to Heritage Western Cape for Mura Solar 1, 2, and 4, and remaining portions of the EGI corridor, falling in the Western Cape, issued by the relevant Heritage Resources Management Agency. The fossil material collected must be curated in an approved repository (*e.g.* museum / university collection). Standards for palaeontological reporting and mitigation in the RSA have been established by Heritage Western Cape (2016, 2021) and SAHRA (2013).

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8. ACKNOWLEDGEMENTS

I am grateful to Ms Surina Laurie of Red Cap for commissioning this study as well as for providing the necessary project information. Professor Bruce Rubidge and Dr Marc van den Brandt of the Evolutionary Studies Institute, Wits University, as well as Dr Mike Day of the Natural History Museum, London, are all thanked for helpful discussions on Karoo palaeontology. Ms Zaituna Skosan and Ms Claire Browning of Iziko Museums, Cape Town kindly facilitated the viewing of a large *Endothiodon* skeleton in the collections of the Karoo Palaeontology Department. 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.

9. 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).

Declaration of Independence

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

Dr John E. Almond
Palaeontologist
***Natura Viva* cc**

APPENDIX 1: PALAEONTOLOGICAL SITE DATA (Nov. 2022): Mura PV Solar and Grid Connection project areas between Beaufort West and Loxton, Western and Northern Cape Provinces.

GPS readings were taken in the field using a hand-held Garmin GPSmap 64s instrument. The datum used is WGS 84. *Please note that locality data for South African fossil sites in not for public release due to conservation concerns.*

Fossil sites are mapped in the context of the proposed layouts of the Mura PV Solar and associated Grid Connection Infrastructure on satellite images in Figures A1.1 and A1.2 below. The fossil sites tabulated and mapped here obviously do not (and cannot) represent *all* fossil sites at surface within the project area but, at most, a representative sample of these. Therefore the absence of recorded fossil sites in a particular area does *not* mean that fossils are not present here at surface or in the subsurface. For this reason, a Chance Fossil Finds Protocol is appended to this report (Appendix 2).

Fossil sites falling within the Northern Cape Province which fall under the heritage management of SAHRA are emphasised with darker brown shading. The remainder of the fossil sites fall within the Western Cape Province.

Specimens noted as **collected** are now curated in the palaeontological collections of the Evolutionary Studies Institute (Wits University, Johannesburg).

Loc.	GPS data	Comments
031	-31.856910° 22.595379°	Poortjie Member. Sneeuw Kraal Farm 46. Unidentifiable bone fragment within small float block of grey-green sandstone. Proposed Field Rating IIIC. No mitigation recommended.
034	-31.846613° 22.585384°	Poortjie Member. Sneeuw Kraal Farm 46 Float blocks of wave-rippled crevasse splay sandstone with low diversity invertebrate trace fossil assemblages – narrow simple or possibly back-filled epichnial burrows. Proposed Field Rating IIIC. No mitigation recommended.
044	-31.834539° 22.566948°	Poortjie Member Duiker Kranse Farm 3/45 Thin, multiple, mudflake-rich, baked basal breccia horizons within or beneath channel sandstone units containing sparse, angular, small (< 1.5 cm), baked fragments of reworked bone. Proposed Field Rating IIIC. No mitigation recommended.
049	-31.830220° 22.558952°	Poortjie Member Duiker Kranse Farm 3/45 Dark grey, locally loaded and wave-rippled siltstones exposed in stream banks showing poorly-preserved *Scoyenia* Ichnofacies invertebrate traces – probably including *Scoyenia* itself. Proposed Field Rating IIIC. No mitigation recommended.
050	-31.829663° 22.558809°	Poortjie Member Duiker Kranse Farm 3/45 Dark grey, locally loaded and wave-rippled siltstones exposed in stream banks showing microbial mat textures (wrinkled, pustulose *etc*) with narrow horizontal burrows of invertebrate undermat miners. Proposed Field Rating IIIC. No mitigation recommended.
052	-31.832827° 22.561828°	Poortjie Member Duiker Kranse Farm 3/45 Baked, dark grey mudrocks containing partial articulated skull and postcrania of small tetrapod – probably a small dicynodont like *Diictodon*. Proposed Field Rating IIIB. No mitigation recommended.
053	-31.832794° 22.561898°	Poortjie Member Duiker Kranse Farm 3/45 Streambed exposure of baked, dark grey mudrocks with abundant pedocrete concretions, also containing smooth, bioturbated burrow floors and occasional scratched burrow casts of small tetrapods – probably of small dicynodonts like *Diictodon*. Proposed Field Rating IIIB. No mitigation recommended.
056	-31.854436°	Poortjie Member mudrock hillslope exposure.

	22.596990°	Sneeuw Kraal Farm 46. Small tetrapod skull preserved within pedocrete concretion in float. Proposed Field Rating IIIB. Specimen collected - no mitigation required.
057	-31.854332° 22.597192°	Poortjie Member mudrock hillslope exposure. Sneeuw Kraal Farm 46. Small dicynodont skull preserved within pedocrete concretion in float. Proposed Field Rating IIIB. **Specimen collected** - no mitigation required.
063	-31.849120° 22.600869°	Upper Poortjie Member, gulley exposure of tabular fine-grained wackes within purple-brown mudrock package. Sneeuw Kraal Farm 46. Disarticulated, fragmentary postcranial bones of medium-sized tetrapod (perhaps *Endothiodon* or therocephalian). Proposed Field Rating IIIB. No mitigation required.
065	-31.849118° 22.602516°	Upper Poortjie Member. Sneeuw Kraal Farm 46. Small skull in concretion in float. Proposed Field Rating IIIB. **Specimen collected** - no mitigation required.
066	-31.847966° 22.601036°	Upper Poortjie Member, hillslope exposure of tabular fine-grained wackes within grey-green mudrock package. Sneeuw Kraal Farm 46. Disarticulated, fragmentary postcranial bones of medium-sized tetrapod (perhaps *Endothiodon* or therocephalian). Proposed Field Rating IIIB. No mitigation required.
067	-31.847848° 22.600579°	Upper Poortjie Member, hillslope exposure of purple-brown and grey-green mudrocks. Sneeuw Kraal Farm 46. Pedocrete concretions containing partial backbone and foot of small-bodied tetrapod (probably dicynodont). Proposed Field Rating IIIC. No mitigation required.
068	-31.847960° 22.600443°	Upper Poortjie Member. Sneeuw Kraal Farm 46. Small dicynodont with broad skull table preserved within pedocrete concretion. Proposed Field Rating IIIB. **Specimen collected** - no mitigation required.
070	-31.843125° 22.591971°	Upper Poortjie Member. Sneeuw Kraal Farm 46. Fragmentary postcranial remains of small tetrapod (probably dicynodont) *in situ* within grey-green siltstone. Proposed Field Rating IIIC. No mitigation required.
071	-31.842932° 22.592243°	Upper Poortjie Member. Sneeuw Kraal Farm 46. Fragmentary cranial, and possibly postcranial, remains of a small dicynodont. Proposed Field Rating IIIC. No mitigation required.
073	-31.822502° 22.586578°	Upper Poortjie Member. Aangresend Abrams Kraal Farm 11. Disturbed friable mudrocks (probable borrow pit) in Mura Solar 4 project area. Possible but equivocal sandstone cast of a tetrapod burrow. Proposed Field Rating IIIC. No mitigation required.
078	-31.803891° 22.597678°	Upper Poortjie Member. RE of Abrams Kraal Farm 206 Gullied exposure of overbank mudrocks and thin channel sandstones with basal breccias. Small reworked bone fragments (*e.g.* narrow ribs) within mudflake-rich breccias. Proposed Field Rating IIIC. No mitigation required.
081	-31.801097° 22.598353°	Upper Poortjie Member. RE of Abrams Kraal Farm 206 Thin sandstone package with ingtermittent basal mudflake breccias containing sparse, disarticulated and fragmentary reworked bones. Proposed Field Rating IIIC. No mitigation required.
083	-31.801586° 22.598406°	Upper Poortjie Member. RE of Abrams Kraal Farm 206 Numerous (several 10s) small bone chunks of robust tetrapod scattered at surface (possibly pachyostosed skull roof of tapinocephalid dinocephalian comprising broad outer zone with prominent radial fibrous texture and occasional narrow radial canals and then spongy-textured inner zone, smooth outer surface, plus occasional rib fragments). Probably weathered-out from channel sandstone upslope. Proposed Field Rating IIIB. **Material well-sampled**. No mitigation required.
087	-31.803414° 22.604588°	Upper Poortjie Member. RE of Abrams Kraal Farm 206 Float block of mottled grey-green / purple-brown wacke containing small vertebra plus

		ribs of small-bodied tetrapod. Proposed Field Rating IIIC. No mitigation required.
088	-31.805458° 22.605826°	Upper Poortjie Member. RE of Abrams Kraal Farm 206 Float block of sandstone with reedy plant stem casts and *Scoyenia* Ichnofacies invertebrate trace fossils. Proposed Field Rating IIIC. No mitigation required.
094	-31.874666° 22.454586°	Hoedemaker Member. Leeuw Kloof Farm 43 Streambed exposure of purple-brown mudrocks with several greenish tetrapod burrow casts, some helical leading into straight burrow section. Proposed Field Rating IIIC. Specimen within stream bed ≥10 m from access road footprint, is recorded and illustrated in this report and represents a common taxon. No mitigation required.
095	-31.874687° 22.454513°	Hoedemaker Member. Leeuw Kloof Farm 43 Same locality as above, showing articulated skull and partial postcrania of a small-bodied dicynodont (probably *Diictodon*), possibly within a burrow cast. Proposed Field Rating IIIC. Specimen within stream bed ≥10 m from access road footprint, is recorded and illustrated in this report and represents a common taxon. No mitigation required.
097	-31.858984° 22.465344°	Hoedemaker Member. Leeuw Kloof Farm 43 Concentration of highly comminuted bone fragments (suncracked, or possibly coprolitic) within fine-grained greenish-purple wacke. Proposed Field Rating IIIC. No mitigation required.
098	-31.856714° 22.467748°	Hoedemaker Member. Leeuw Kloof Farm 43 Hackly-weathering purple-brown mudrocks with moulds of finely longitudinally striated plant axes (*c*. 3 cm wide) – probably stems of sphenophyte ferns. Proposed Field Rating IIIC. No mitigation required.
102	-31.857688° 22.464083°	Hoedemaker Member. Leeuw Kloof Farm 43 Small, poorly preserved, fragmentary skull (probably dicynodont) within pedocrete concretion among surface gravels. Proposed Field Rating IIIC. No mitigation required.
107	-31.842793° 22.495313°	Hoedemaker Member Duiker Kranse Farm 4/45 Fine-grained, baked wackes with *Scoyenia* Ichnofacies meniscate back-filled invertebrate burrows. Proposed Field Rating IIIC. No mitigation required.
121	-31.875422° 22.541735°	Poortjie Member Duiker Kranse Farm 3/45 Sole surfaces of sandstone float blocks with low diversity invertebrate trace fossil assemblages plus *possible* digital prods of temnospondyl amphibians (unconfirmed). Proposed Field Rating IIIC. No mitigation required.
125	-31.858777° 22.537601°	Hoedemaker Member Duiker Kranse Farm 3/45 (Eldorado 45 on map sheet 3122CD). Surface gravels of weathered-out pedocrete concretions overlying purple-brown mudrocks with occasional postcranial skeletal remains of small tetrapods (probably dicynodonts) within some concretions. Proposed Field Rating IIIC. No mitigation required.
127	-31.851937° 22.547775°	Hoedemaker Member Duiker Kranse Farm 3/45 (Eldorado 45 on map sheet 3122CD). Good hillslope exposure of purple-brown mudrocks and thin, grey-green crevasse splay sandstones. Small dicynodont skull with articulated lower jaw in surface float (probably *Diictodon*). Proposed Field Rating IIIB. **Specimen collected** - no mitigation required.
129	-31.851661° 22.548836°	Hoedemaker Member. Duiker Kranse Farm 3/45 (Eldorado 45 on map sheet 3122CD). Probable vertebratal remains (2 fragments) of large-bodied tetrapod – possibly the dicynodont *Endothiodon* – within float. Proposed Field Rating IIIB. **Specimens collected** - no mitigation required.
399	-31.800737° 22.598482°	Poortjie Member RE of Abrams Kraal Farm 206 Float block of grey-green wacke containing reworked bone fragments. Proposed Field Rating IIIC. No mitigation required.
403	-31.801620°	Poortjie Member

	22.598443°	RE of Abrams Kraal Farm 206 Sandstone float block with mould of fragmentary bone, possibly with cracked surface. Proposed Field Rating IIIC. No mitigation required.
407	-31.800899° 22.596903°	Poortjie Member RE of Abrams Kraal Farm 206 Float block of mudflake breccio-conglomerate containing bone fragments. Proposed Field Rating IIIC. No mitigation required.
408	-31.800920° 22.596965°	Poortjie Member RE of Abrams Kraal Farm 206 Float block of mudflake breccio-conglomerate containing mould of sizeable ridged bone fragment (*possibly* part of pectorial girdle of large tetrapod). Proposed Field Rating IIIB. **Specimen collected** - no mitigation required.
410	-31.801098° 22.598367°	Poortjie Member RE of Abrams Kraal Farm 206 Mudflake and calcrete glaebule breccia lens beneath thin channel sandstone containing bone fragments. Proposed Field Rating IIIC. No mitigation required.
411	-31.801313° 22.598210°	Poortjie Member RE of Abrams Kraal Farm 206 Three fragments of white bone, probably weathered-out of channel breccias. Proposed Field Rating IIIC. No mitigation required.
412	-31.801943° 22.599670°	Poortjie Member RE of Abrams Kraal Farm 206 Isolated fragment of white spongy bone in float, probably weathered-out of channel breccias. Proposed Field Rating IIIC. No mitigation required.
421	-31.807901° 22.608574°	Poortjie Member RE of Abrams Kraal Farm 206 Purplish-brown sandstone float blocks with poorly-preserved invertebrate burrows. Proposed Field Rating IIIC. No mitigation required.
444	-31.863688° 22.604818°	Upper Poortjie Member Sneeukraal Farm 46 Mudflake breccias within upper part of sandstone package on western slopes of Perdeberg with occasional carbonaceous compressions of plant material (*c*. 4 cm wide). Proposed Field Rating IIIC. No mitigation required.

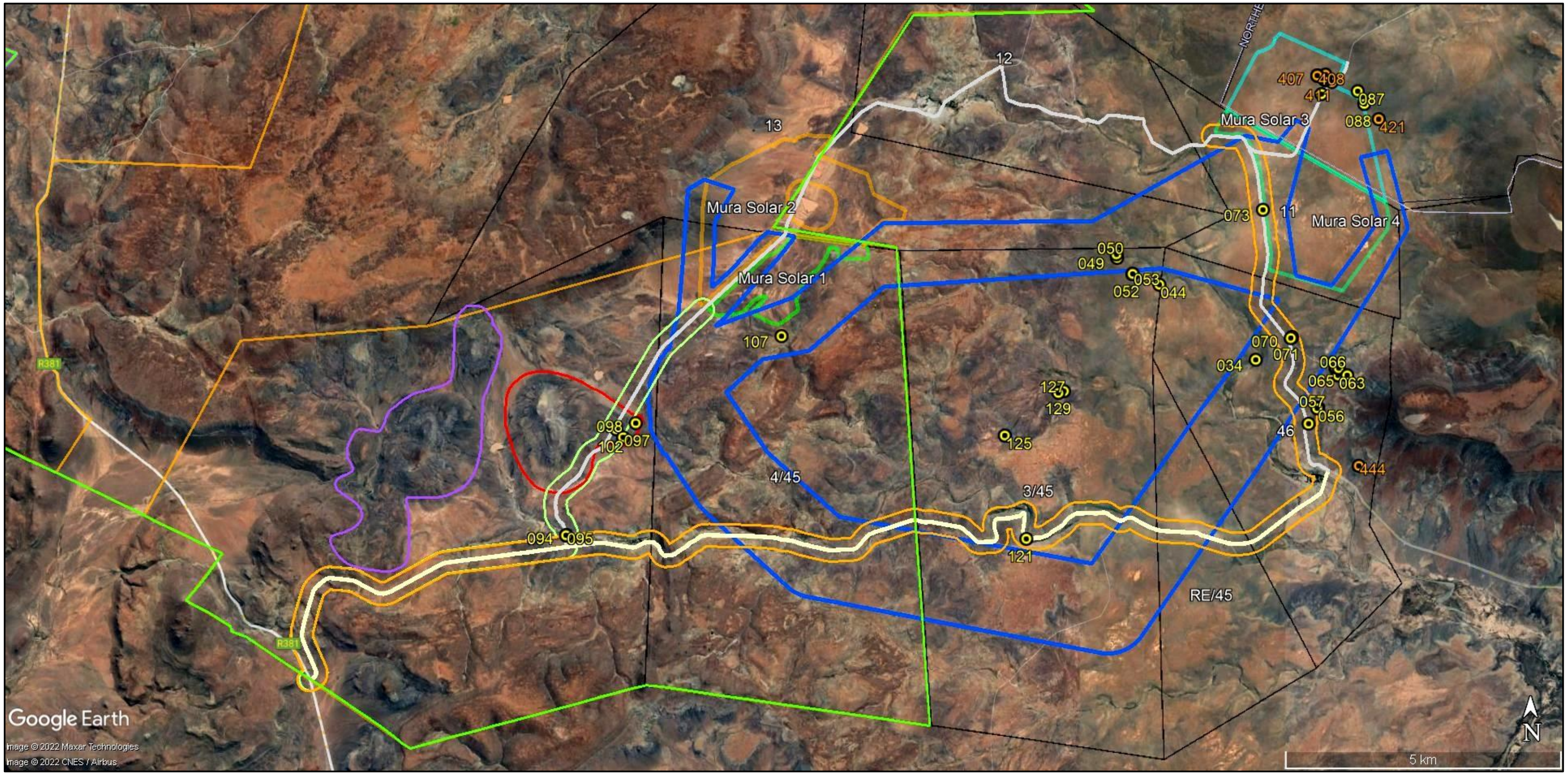

Figure A1.1: Google Earth© satellite image of the Mura PV Solar, access roads and EGI project areas near Loxton showing the location of recently recorded fossil sites (numbered yellow and orange circles) in relation to the project footprints (See table above for site data). Specimens falling within or close to the footprints are either of low scientific and conservation value or have already been collected (ESO collections, Wits University). Therefore no further mitigation with respect to the known sites is recommended here.

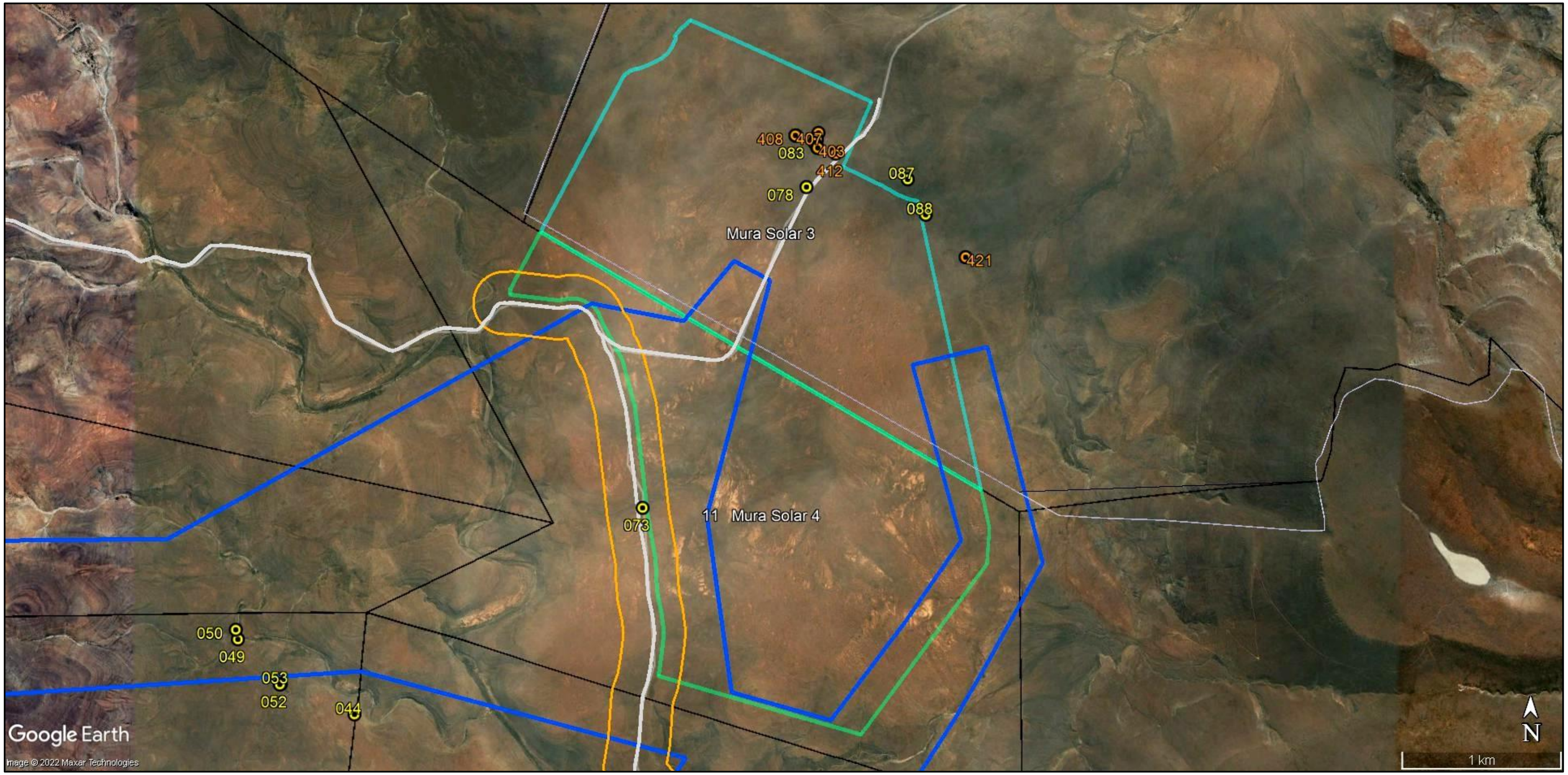

Figure A1.2: Google Earth© satellite image of the Mura PV Solar 3 and 4 project areas showing the location of recently recorded fossil sites (numbered yellow and orange circles) in relation to the project footprints (See table above for site data). Specimens falling within or close to the footprints are either of low scientific and conservation value or have already been collected (ESO collections, Wits University). Therefore no further mitigation with respect to the known sites is recommended here. Sites within the Mura PV Solar 3 project area on the RE of Abrams Kraal Farm 206 lie within the Northern Cape Province and fall under the jurisdiction of SAHRA.

<table>
<tr><th colspan="3">APPENDIX 2 - CHANCE FOSSIL FINDS PROCEDURE: Mura PV Solar projects and associated grid connection infrastructure between Loxton and Beaufort West</th></tr>
<tr><td>Province & region:</td><td colspan="2">Northern Cape (Pixley Ka-Seme District) and Western Cape (Central Karoo District)</td></tr>
<tr><td>Responsible Heritage Management Agencies</td><td colspan="2">SAHRA for N. Cape: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za
HERITAGE WESTERN CAPE for W. Cape. Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 021 483 9598. E-mail: ceoheritage@westerncape.gov.za</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Poortjie and Hoedermaker Members of the Teekloof Formation (Lower Beaufort Group), Late Caenozoic alluvium.</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Fossil skulls, postcrania of tetrapods, amphibians, fish as well as rare petrified wood, plant compressions, vertebrate and invertebrate burrows within bedrocks. Mammalian bones, teeth & horn cores, freshwater molluscs, calcretised trace fossils & rhizoliths and plant material in 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">Apply for Fossil Collection Permit Record / submit Work Plan to relevant Heritage Resources Agency. 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>
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