

Palaeontological Heritage: combined desktop and field-based Compliance Statement

PROPOSED LOXTON WEF CLUSTER, UBUNTU LOCAL MUNICIPALITY AND THE PIXLEY KA SEME DISTRICT MUNICIPALITY IN THE NORTHERN CAPE PROVINCE.

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November 2022

EXECUTIVE SUMMARY

It is proposed to develop three commercial Wind Energy Facilities (WEFs) - known as Loxton WEF 1, Loxton WEF 2 and Loxton WEF 3 - and associated infrastructure on a site located c. 30 km north of Loxton within the Ubuntu Local Municipality (Pixley Ka Seme District Municipality) in the Northern Cape Province.

Historical palaeontological site mapping for the region between Loxton and Victoria West reveals a paucity of recorded vertebrate fossil sites within the Loxton WEF Cluster project area. This is supported by recent palaeontological field surveying, both here and in neighbouring WEF project areas, which shows that:

(1) Levels of Beaufort Group bedrock exposure are very limited here due to pervasive cover by Late Caenozoic superficial sediments; (2) Intensive intrusion by dolerite sills and dykes has compromised fossil preservation over large areas; (3) The Beaufort Group bedrocks represented here span the catastrophic end-Middle Permian Extinction Event which is associated with an unusually low abundance of well-preserved fossil remains.

Over the course of eight days, only a handful of fossil sites were recorded within the WEF Cluster project area, the majority of which are poorly preserved and of limited scientific or conservation significance. Even occasional small areas showing excellent, fresh mudrock exposure ideal for palaeontological recording yielded hardly any fossils. No fossil sites were recorded within the Late Caenozoic superficial deposits.

While additional, unrecorded fossil sites of high palaeontological and conservation value are likely to occur at and beneath the land surface within the Loxton WEF Cluster project areas, they are probably very sparse and sporadic in distribution and can be effectively handled in the Construction Phase through a Chance Fossil Finds Protocol (See Appendix 1). All the recorded sites can, if necessary, be effectively mitigated in the preconstruction phase.

It is concluded that the palaeosensitivity of the combined Loxton WEF Cluster project area is, in practice, LOW. The provisional palaeosensitivity mapping by the DFFE Screening Tool is accordingly *contested* in this report.

Despite the substantial WEF project footprints as well as the known occurrence of important vertebrate and other fossil sites elsewhere in the wider region between Loxton and Victoria West, **the impact significance of the proposed renewable energy developments on local palaeontological heritage is anticipated to be LOW.** These impacts, including cumulative impacts considering other

renewable energy projects in the broader region, are expected to fall within acceptable limits. There are therefore no objections on palaeontological heritage grounds to authorisation of the Loxton WEF Cluster developments.

The potential for unrecorded palaeontological sites of scientific and conservation value cannot be completely excluded. These are best mitigated through the application of a Chance Fossil Finds Protocol by the ECO / ESO during the Construction Phase (See Appendix 1) which should be incorporated into the EMPs for the WEF developments. The qualified palaeontologist responsible for mitigation work will need to apply for a Fossil Collection Permit for the Northern Cape from SAHRA. Minimum standards for PIA reports have been compiled by Heritage Western Cape (2021) and SAHRA (2013).

Given the inferred low overall site sensitivity and anticipated impact significance, formal palaeontological heritage impact assessment for the proposed Loxton WEF Cluster projects is not considered necessary. However, a combined desktop and field-based palaeontological heritage report outlining and mapping the recorded fossil sites and their geological context should be submitted to SAHRA as part of the Heritage Assessment process.

1. Project outline

The applicants Loxton Wind Facility 1 (Pty) Ltd, Loxton Wind Facility 2 (Pty) Ltd and Loxton Wind Facility 3 (Pty) Ltd are proposing the development of three commercial Wind Energy Facilities (WEFs) and associated infrastructure on a site located approximately 30 km north of Loxton within the Ubuntu Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province.

The three WEF's being considered across numerous properties and are each assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained in Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Loxton WEF 1, Loxton WEF 2 and Loxton WEF 3.

A preferred project site with an extent of approximately 58 000 ha has been identified as a technically suitable area for the development of the three WEF projects. Loxton WEF 1 will comprise of up to 38 turbines, Loxton WEF 2 up to 63 turbines and Loxton WEF 3 up to 41 turbines. Loxton WEF 1 and Loxton WEF 3 will each have a contracted capacity of up to 240MW with a permanent footprint of up to 65 ha whereas Loxton WEF 2 will comprise of up to 63 turbines with a contracted capacity of up to 480 MW and permanent footprint of up to 110 ha.

2. Data sources

The desktop and field-based palaeontological heritage study of the Loxton WEF Cluster project area is based on the following information resources:

1. A project outline, kmz files, screening report and maps provided by Atlantic Renewable Energy Partners (Pty) Ltd (Contact details: Peter Smith. Atlantic Renewable Energy Partners (Pty) Ltd. Address: 101, Block A, West Quay Building, 7 West Quay Road, Waterfront, Cape Town, 8000 RSA. Tel: + 27 (21) 418 2596, Fax: + 27 (0) 86 611 0882. E-mail: peter@atlanticep.com).

2. A desktop review of:

(a) the relevant 1:50 000 scale topographic maps (3122AB Alarmkraal, 3122AD Loxton, 3122BC Schimmelfontein, 3122CB Slangfontein, 3122DA Slypfontein) and the 1:250 000 scale topographic map 3122 Victoria West);

(b) Google Earth© satellite imagery;

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

(d) several previous and on-going fossil heritage (PIA) assessments for renewable energy and transmission line projects in the Karoo region between Beaufort West, Loxton and Victoria West by the author (See References under Almond as well as on-going work by the author on the neighboring Victoria West WEF Cluster);

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

4. An eight-day palaeontological heritage survey of the combined Loxton WEF Cluster project area by the author and an experienced field assistant between 17 and 26 October 2022. The season in which the site visit took place does not have a critical bearing on this palaeontological study. Extensive grass cover as well as locally impassable farm roads limited bedrock visibility and site access in some areas but these constraints do not markedly affect the conclusions reached in this report, confidence levels for which are rated as Medium to High.

3. Legislative context

All palaeontological heritage resources in the Republic of South Africa are protected by the National Heritage Resources Act (Act 25 of 1999). Heritage resource management in the Northern Cape: is the South African Heritage Resources Agency (Contact details: 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).

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act (Act 25 of 1999) include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites; and
- palaeontological objects and material, meteorites and rare geological specimens.

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

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

(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 agency, or to the nearest local agency offices or museum, which must immediately notify such heritage resources Agency.

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

(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 agency 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 agency 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 recently been published by SAHRA (2013) and Heritage Western Cape (2021).

4. Geological context of WEF project area

The Loxton WEF Cluster project area comprises semi-arid, gently hilly, rocky to sandy and gravelly terrain of the Upper Karoo, situated at elevations between c. 1390 and 1580m amsl. to the east of the small town of Loxton and the Loxton – Camarvon road (R63) as well as straddling the R63 road sector between Loxton and Victoria West (1: 250 000 sheet 3122 Victoria West; 1: 50 000 sheets 3122AB Alarmskraal, 3122 AD Loxton, 3122BC Schimmelfontein, 3122CB Slangfontein, 3122DB Slypfontein). Much of the terrain is of fairly subdued, rolling relief, with occasional dolerite-capped *koppies* and ridges, especially in the south (e.g. Kleinberg 1534 m, Die Rooikoppie 1514 m, Rooiaar dyke just east of the project area). There are no major rivers; much of the area is drained by a network of small, mostly unnamed, non-perennial streams (e.g. Springbokfontein se Leegte), variously draining SW into the Loxton Dam and Biesjespoort Dam and the Soutpoortrivier or eastwards into the Klein-Brakrivier and the Bitterwaterspruit.

The geology of the WEF Cluster project area is outlined on 1: 250 000 geological sheet 3122 Victoria West (Council for Geoscience, Pretoria) (Figure 1) with a short accompanying explanation by Le Roux & Keyser (1988). The area is largely underlain at depth by continental (fluvial / lacustrine) sediments of the **Lower Beaufort Group** (Karoo Supergroup) of Middle to Late Permian age (c. 260 to 256 Ma = million years ago) (Johnson *et al.* 2006). The sedimentary succession in the north-western sector of the Main Karoo Basin represented here broadly gets younger from north to south. The beds here are assigned to the **Abrahamskraal Formation** and the lowermost, sandstone-rich part of the **Teekloof Formation (Poortjie Member)**, while the overlying mudrock-dominated **Hoedemaker Member** only crops out within the associated Grid Connection corridor towards Victoria West (to be separately assessed). The fine-scale lithostratigraphy of the Lower Beaufort Group succession in this sector of the Main Karoo Basin - including the correlation of the main channel sandstone packages such as the Poortjie Member - remains unresolved (*cf* Day & Rubidge 2020a).

In this subregion of the Upper Karoo the Beaufort Group sediments are intruded by an extensive network of dyke and sill complexes of the Early Jurassic **Karoo Dolerite Suite**, especially in the

southern sector of the combined project area (e.g. Kleinberg 1534 m, Die Rooikoppie 1514 m, Rooiaar dyke just east of the project area) (Chevallier & Woodford 1999, Duncan & Marsh 2006). These intrusions have thermally metamorphosed and altered the adjoining country rocks, locally compromising fossil preservation as well as generating large volumes of tough quartzitic colluvial and eluvial rubble that mantles the neighbouring potentially fossiliferous bedrocks. Kimberlite pipes or other intrusions are not mapped within the project area itself but do occur shortly to the east (small black diamond symbols on the geological map).

Levels of tectonic deformation (including folding, cleavage development) within the wider region are probably low; satellite imagery suggests that the Beaufort Group sediments are fairly flat-lying while they are also cut by numerous small faults which are often picked out by dark lines of shrubs as well as by dolerite dykes.

The Permian and Jurassic bedrocks within the project area are extensively mantled by a range of **Late Caenozoic superficial deposits**, limiting exposure levels of fresh (unweathered), potentially fossiliferous Permian sediments. In addition to thick alluvial sediments along numerous active or defunct drainage lines, these younger cover sediments include pan and spring deposits, colluvial (slope) and eluvial (downwasted) surface gravels, pedocretes (e.g. calcrete hardpans, especially in doleritic terrain) *plus* a spectrum of mainly sandy to gravelly soils.

5. Palaeontological heritage context

The Middle to Late Permian Abrahamskraal and Teekloof Formation bedrocks in the combined Loxton Cluster study area are characterised by fossil assemblages of the ***Tapinocephalus* and *Endothiodon* Assemblage Zones** (the latter was previously termed the *Pristerognathus* and *Tropidostoma* Assemblage Zones (Kitching 1977, Keyser & Smith 1977-78, Rubidge 1995, Rubidge 2005, Van der Walt *et al.* 2010, Smith *et al.* 2012, Smith *et al.* 2020, Day & Rubidge 2020b, Day & Smith 2020) (Figures 2 and 3). They include a wide range of fossil tetrapods - especially reptiles and therapsids ("mammal-like reptiles" or protomammals") - as well as fish, amphibians, plant remains (e.g. petrified wood, plant compressions), microfossils and trace fossils (e.g. vertebrate and invertebrate burrows, trackways). These fossil assemblages and the sedimentary bedrocks within which they occur are of special scientific interest because they span the environmentally critical boundary between the Middle and Late Permian Periods which was associated with the catastrophic end-Capitanian Mass Extinction Event of c. 260 Ma (million years ago) (Day *et al.* 2015).

Only a few historical vertebrate fossil sites are mapped near Loxton on the published 1: 250 000 geological map and in the key early review by Kitching (1977). The Karoo fossil vertebrate site map of Nicolas (2007) shows low density of fossil records east of Loxton with just a few sites recorded south and north of the town (Figure 4). The region between Loxton and Victoria West is the subject of ongoing palaeontological research by Professor Bruce Rubidge of the Evolutionary Studies Institute (ESI), Wits University as well as Dr Mike Day of the Natural History Museum, London. Important concentrations of fossil sites are known c. 20 km east of the WEF project area near Melton Wold and west of Gamma Substation as a result of a long history of palaeontological fieldwork in the Biesiespoort area (close to the eastern sector of the associated Grid Connection Corridor). Recent palaeontological fieldwork by the present author for WEF and SEF project areas in the broader Loxton – Victoria West – Beaufort West region (e.g. Nuweveld WEFs, Hoogland WEFs, Modderfontein WEF, Victoria West WEF Cluster, Skietkuil / iLanga project areas – see References under Almond) and earlier research by other Karoo palaeontologists (e.g. Smith 1993) suggest that unrecorded fossil sites of scientific and conservation value are likely to occur here. However, vertebrate fossil records are often sparse in areas intruded by dolerite. New tetrapod fossil finds within the project area should help resolve outstanding lithostratigraphic ambiguities in the region as well as contributing to on-going

scientific research concerning palaeoenvironmental and evolutionary events before and during the catastrophic end-Middle Permian Extinction Event of c. 260 million years ago as well as during the succeeding biotic recovery (Retallack *et al.* 2006, Day *et al.* 2015).

Most of the varied Late Caenozoic superficial sediments within the project area are largely of low palaeosensitivity. However, relict and often consolidated older (Neogene / Pleistocene) alluvial deposits along drainage lines might contain sporadic fossil assemblages of mammals (bones, teeth, horn cores), freshwater invertebrates (e.g. unionid bivalves) and trace fossils (e.g. calcretised termitaria, rhizoliths / plant root casts).

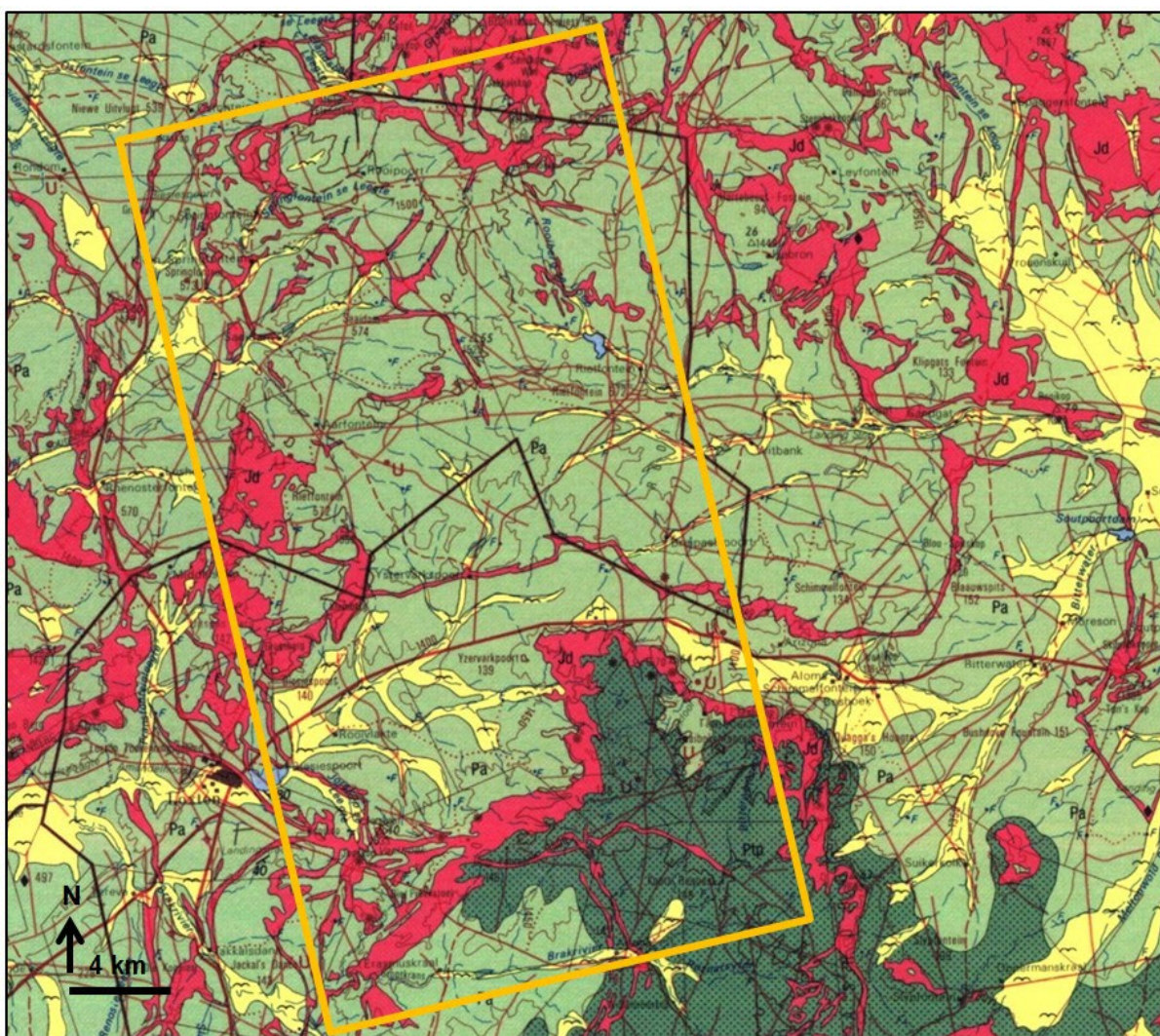


Figure 1: Extract from 1: 250 000 geology sheet 3122 Victoria West showing the *approximate* location of the proposed Loxton WEF Cluster project area between Loxton and Victoria West, Northern Cape (Base map published by the Council for Geoscience, Pretoria). The main rock units represented regionally include: Pa (pale green) = Middle to Late Permian Abrahamskraal Formation. Ptp (middle green with stipple) = Late Permian Poortjie Member, Teekloof Formation (Adelaide Subgroup). Pth (middle green without stipple) = Late Permian Hoedemaker Member, Teekloof Formation (Adelaide Subgroup). Jd (red) = dolerite sills and dykes of the Early Jurassic Karoo Dolerite Suite. Pale yellow with flying bird symbol = Late Caenozoic (Neogene / Pleistocene to Recent) alluvium. Small black diamonds – kimberlite pipes. *N.B.* The mapping of the various members within the Teekloof Formation shown in this region is contested.

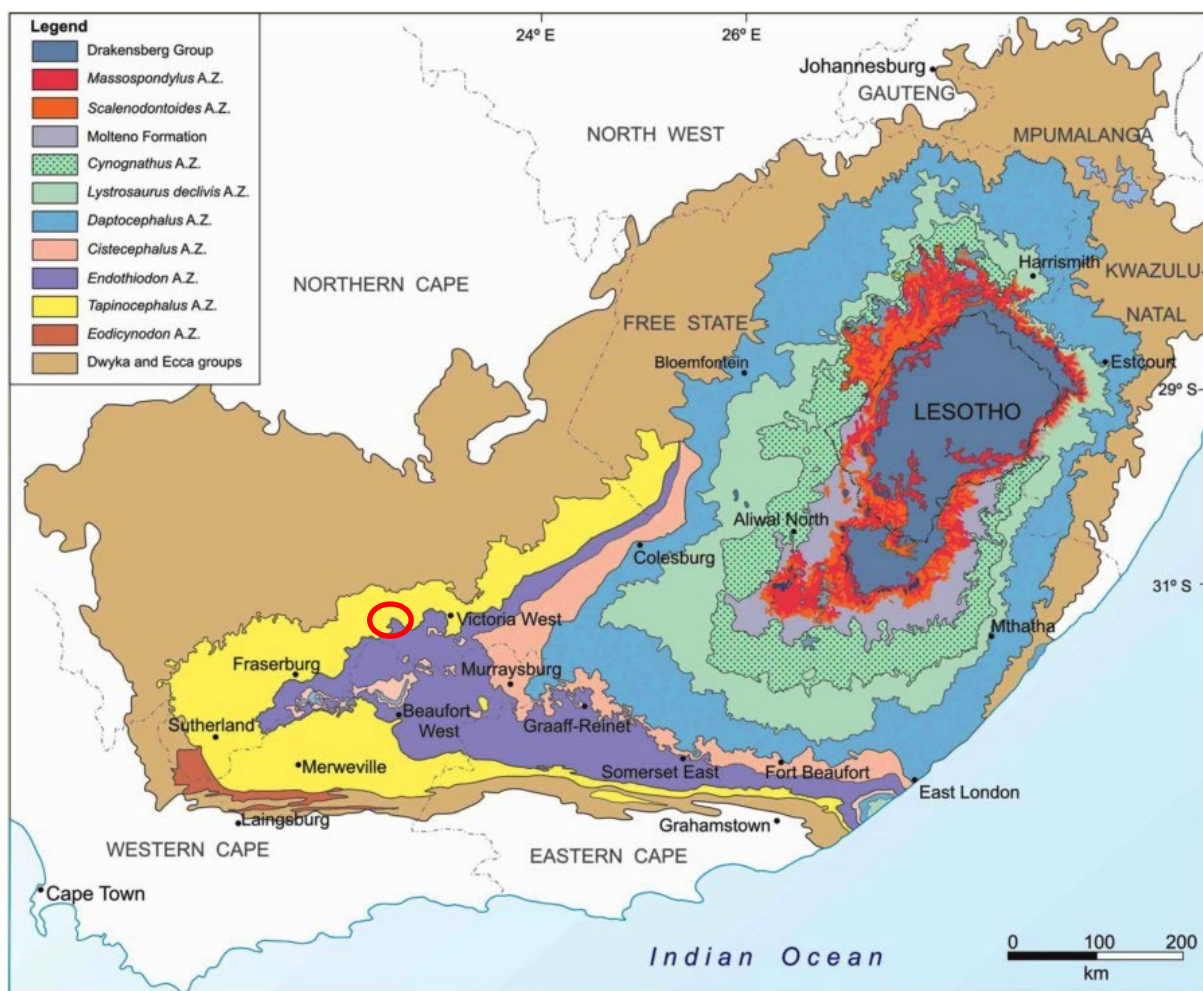


Figure 2: The latest fossil biozonation map for the Main Karoo Basin (Smith *et al.* 2020) shows the occurrence of Mid to Late Permian fossil assemblages of the *Tapinocephalus* Assemblage Zone and the succeeding *Endothiodon* Assemblage Zone in the Loxton WEF Cluster project area (small red ellipse).

Age	Gp	West of 24° E	East of 24° E	Free State / KwaZulu-Natal	Vertebrate Assemblage Zones	Vertebrate Subzones	Radiometric dates	
JURASSIC	STORMBERG		Drakensberg Gp	Drakensberg Gp			← 183.0 Ma (A)	
			Clarens Fm	Clarens Fm	<i>Massospondylus</i>		← <187.5 Ma (B)	
			upper Elliot Fm	upper Elliot Fm			← <191.9 Ma (B)	
TRIASSIC	Tarkastad Subgp		lower Elliot Fm	lower Elliot Fm		<i>Scalenodontoides</i>		← <199.9 Ma (B)
			Molteno Fm	Molteno Fm				← <204 Ma (B)
			Burgersdorp Fm	Driekoppen Fm		<i>Cynognathus</i>	<i>Cricodon-Ufudocyclops</i> <i>Trirachodon-Kannemeyeria</i> <i>Langbergia-Gargainia</i>	← <219 Ma (B)
		Katberg Fm	Verkykerskop Fm		<i>Lystrosaurus declivis</i>			
		Palingkloof M.					← 252.24 Ma (G)	
BEAUFORT	Adelaide Subgp		Balfour Fm	Harrismith M.	<i>Daptocephalus</i>	<i>Lystrosaurus maccaigi-Moschorhinus</i>	← 251.7 Ma (C)	
				Elandsberg M.			Schoondraai M.	← 253.02 Ma (D)
				Ripplemead M.			Rooinekke M.	
				Daggaboersnek M.			Frankfort M.	
				Steenkampsvlakte M.				
			Oukloof M.	Oudeberg M.	<i>Cistecephalus</i>	← 255.2 Ma (E)		
			Hoedemaker M.	Middleton Fm		← 256.247 Ma (E)		
			Poortjie M.		<i>Endothiodon</i>	← 259.262 Ma (E)		
			Abrahamskraal Fm	Koonap Fm	<i>Tapinocephalus</i>	← 260.259 Ma (F)		
					<i>Eosimops-Glanosuchus</i>	← 260.407 Ma (E)		
PERMIAN	ECCA	Waterford Fm	Waterford Fm		<i>Eodicynodon</i>		← 261.241 Ma (E)	
		Tierberg/Fort Brown	Fort Brown					

Figure 3: 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 within the Loxton WEF Cluster project area are outlined in red respectively. The Hoedemaker Member is only present within the associated Grid Connection corridor (to be assessed separately). The detailed mapping of these lithostratigraphic and biostratigraphic units within the present project area between Loxton and Beaufort West is unresolved at present.

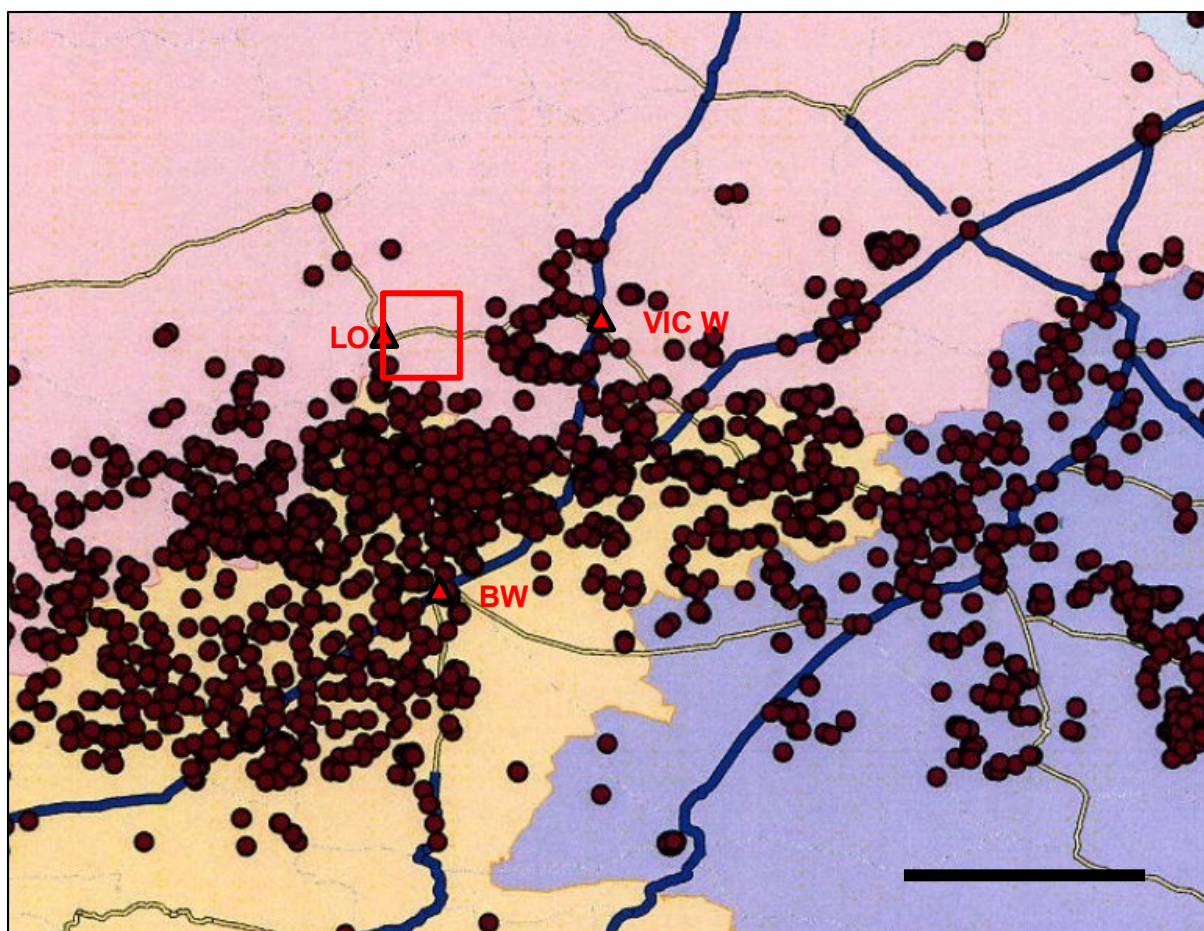


Figure 4: Distribution map of recorded vertebrate fossil sites within the Lower Beaufort Group of the Great Karoo between Loxton (LOX), Victoria West (VIC W) and Beaufort West (BW), showing the very *approximate* outline of the study area for the Loxton WEF Cluster within the red rectangle (map abstracted from Nicolas 2007). Note the scarcity of known sites in the area just to the east of Loxton, with a few sites recorded just to the north and south of the town. The abundance of known fossil sites close to the N1 to the northeast of Three Sisters and south of Victoria West reflects in part the long history (> 100 years) of fossil collection by both academics as well as knowledgeable amateurs at sites close to Biesiespoort Station. Scale bar = 10 km. N towards the top of the image.

6. Palaeontological heritage site sensitivity verification

Provisional sensitivity mapping using the DFFE Screening Tool (Figures 5 and 6) as well as the SAHRIS palaeosensitivity map (SAHRIS Website) suggests that most of the combined Loxton WEF Cluster project area is of **Very High Palaeosensitivity**, primarily based on the presence here of potentially fossiliferous Lower Beaufort Group bedrocks. Thick alluvial deposits are assigned a **Medium Sensitivity** while dolerite intrusions are **Insensitive** (*i.e.* unfossiliferous). Based on (1) recent experience with WEF projects in the broader region (notably the Victoria West WEF Cluster immediately to the east), (2) desktop analysis of vertebrate fossil sites in the Main Karoo Basin, as well as the recent eight-day palaeontological heritage of the Loxton WEF Cluster project area, this preliminary palaeosensitivity mapping is critically re-assessed in this report.

Fossil site maps for the region between Loxton and Victoria West (*e.g.* Nicolas 2007; Figure 4 herein) show a paucity of sites within the Loxton WEF Cluster project area. This cannot be attributed simply

to the lack of palaeontological fieldwork in the area, however. Recent palaeontological field surveying shows that:

(1) Levels of Beaufort Group bedrock exposure are very limited here due to pervasive cover by Late Caenozoic superficial sediments (e.g. colluvial and eluvial gravels, alluvial soils);

(2) Intensive intrusion by dolerite sills and dykes has altered the sedimentary country rocks through thermal metamorphism and hydrothermal activity (viz. circulation of hot, mineralizing ground waters) which has compromised fossil preservation over large areas;

(3) The Beaufort Group bedrocks represented here (uppermost Abrahamskraal Formation – Poortjie Member interval) span the catastrophic end-Middle Permian Extinction Event which is associated with an unusually low abundance of well-preserved fossil remains. Over the course of eight days, only a handful of fossil sites were recorded within Beaufort group bedrocks underlying the WEF Cluster project area, the majority of which are poorly preserved and of limited scientific or conservation significance. Even occasional small areas showing excellent, fresh (i.e. unweathered) mudrock exposure ideal for palaeontological recording yielded hardly any fossils. No fossil sites were recorded within the Late Caenozoic superficial deposits.

While additional, unrecorded fossil sites of high palaeontological and conservation value are likely to occur at and beneath the land surface within the Loxton WEF Cluster project areas, they are probably very sparse and sporadic in distribution and can be effectively handled in the Construction Phase through a Chance Fossil Finds Protocol (See Appendix 1). All the recorded sites can, if necessary, be effectively mitigated in the preconstruction phase.

It is concluded that the palaeosensitivity of the combined Loxton WEF Cluster project area is, in practice, LOW. The provisional palaeosensitivity mapping by the DFFE Screening Tool is accordingly contested in this report.

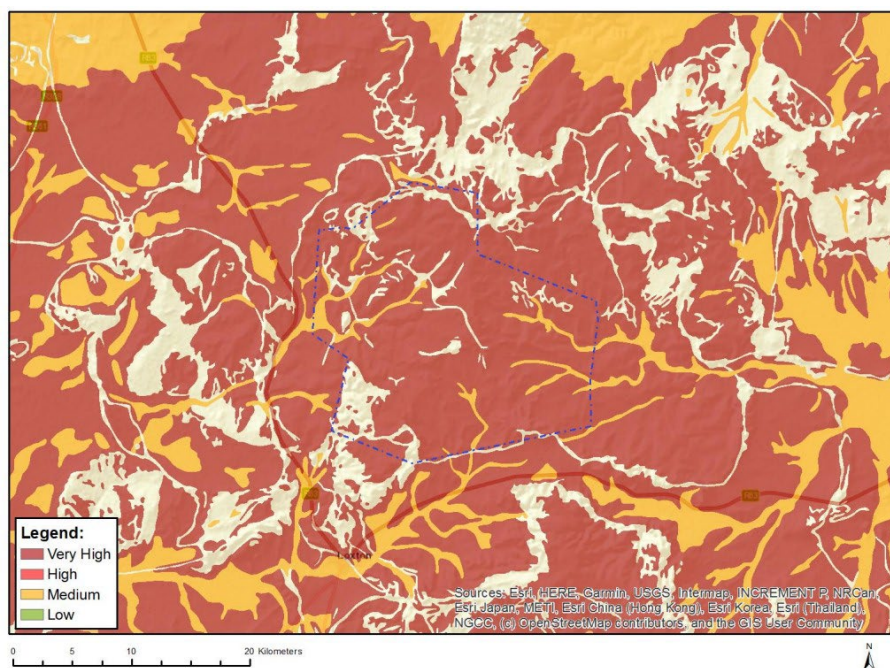


Figure 5: Provisional palaeosensitivity mapping of the northern sector of the Loxton WEF Cluster project area using the DFFE Screening Tool. The Very High sensitivity of most of the project area is *contested* in this report.

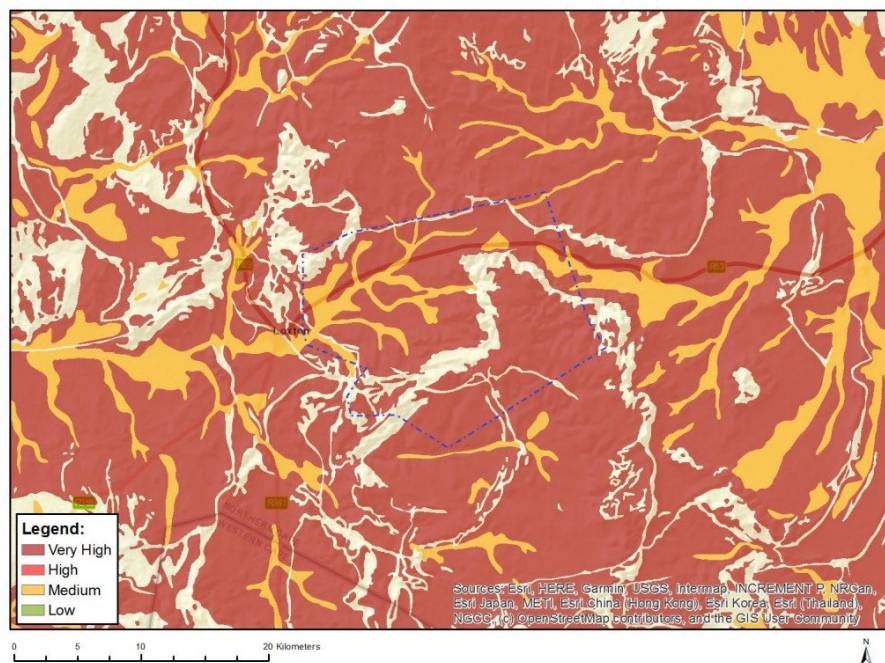


Figure 6: Provisional palaeosensitivity mapping of the southern sector of the Loxton WEF Cluster project area using the DFFE Screening Tool. The Very High sensitivity of most of the project area *contested* in this report.

7. Potential impacts on palaeontological heritage and mitigation

The proposed Loxton WEF Cluster projects will involve substantial surface clearance and bedrock excavations - for example for wind turbine foundations, access road networks, underground cables, construction laydown areas/camps, operation & maintenance buildings, on-site substations and electrical pylon footings - which may disturb, damage or destroy legally projected palaeontological heritage resources of scientific and conservation value.

Despite the substantial project footprints as well as the known occurrence of important vertebrate and other fossil sites elsewhere in the wider region between Loxton and Victoria West, **the impact significance of the proposed renewable energy developments on local palaeontological heritage is anticipated to be LOW.** This is based on the inferred Low Palaeosensitivity of the project area overall based on desktop and field-based data, as motivated above. These impacts, including cumulative impacts considering other renewable energy projects in the broader region, are expected to fall within acceptable limits.

The potential for unrecorded palaeontological sites of scientific and conservation value cannot be completely excluded, however. These are best mitigated through the application of a Chance Fossil Finds Protocol by the ECO / ESO during the Construction Phase (See Appendix 1) which should be incorporated into the EMPs for the WEF developments. The qualified palaeontologist responsible for mitigation work will need to apply for a Fossil Collection Permit for the Northern Cape from SAHRA. Minimum standards for PIA reports have been compiled by Heritage Western Cape (2021) and SAHRA (2013).

8. Conclusions

Historical palaeontological site mapping for the region between Loxton and Victoria West reveals a paucity of recorded vertebrate fossil sites within the Loxton WEF Cluster project area. This is supported by recent palaeontological field surveying, both here and in neighbouring WEF project areas, which shows that:

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Given the inferred low overall site sensitivity and anticipated impact significance, formal palaeontological heritage impact assessment for the proposed Loxton WEF Cluster projects is not considered necessary. However, a combined desktop and field-based palaeontological heritage report outlining and mapping the recorded fossil sites and their geological context should be submitted to SAHRA as part of the Heritage Assessment process.

9. Key references

ALMOND, J.E. & PETHER, J. 2008. Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.

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10. Outline of specialist's experience

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 - CHANCE FOSSIL FINDS PROCEDURE: Loxton WEF Cluster near Loxton, Northern Cape Province	
Province & region:	Northern Cape (Pixley Ka-Seme District, Ubuntu Local Municipality)
Responsible Heritage Management Agencies	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
Rock unit(s)	Abrahamskraal Formation and Teekloof Formation (Lower Beaufort Group), Late Caenozoic alluvium.
Potential fossils	Fossil skulls, postcrania of tetrapods, amphibians, fish as well as rare petrified wood, vertebrate and invertebrate burrows within bedrocks. Mammalian bones, teeth & horn cores, freshwater molluscs, calcretised trace fossils & rhizoliths and plant material in alluvium.
ECO / ESO protocol	1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (<i>N.B.</i> safety first!), safeguard site with security tape / fence / sand bags if necessary.
	2. Record key data while fossil remains are still <i>in situ</i> : <ul style="list-style-type: none"> • 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) <i>in situ</i> with scale, from different angles, including images showing context (e.g. rock layering)
	3. If feasible to leave fossils <i>in situ</i> : <ul style="list-style-type: none"> • 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
	3. If <i>not</i> feasible to leave fossils <i>in situ</i> (emergency procedure only): <ul style="list-style-type: none"> • <i>Carefully</i> 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
	4. If required by Heritage Resources Agency, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.
5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Agency	
Specialist palaeontologist	Apply for Fossil Collection Permit Record / submit Work Plan to the 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.