PALAEONTOLOGICAL HERITAGE SPECIALIST ASSESSMENT: DESKTOP STUDY

New Citrus Orchards on the Farm Alicedale 138 MT, near Tshipise, Vhembe District Municipality, Limpopo Province.

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EXECUTIVE SUMMARY

Alicedale Estates (Pty) Ltd has undertaken the unauthorised cultivation of virgin veld in order to plant citrus trees on two separate areas with a total area of *c*. 200 ha on the farm Alicedale 138 MT, situated on the northern side of the R525 some 5 km southwest of Tshipise and *c*. 35 km WSW of Musina in the Vhembe District Municipality, Limpopo Province.

The citrus orchard project area is underlain by (1) unfossiliferous, highly-metamorphosed Precambrian basement rocks of the Beitbridge Complex, (2) small outcrop areas of Karoo Supergroup sediments of the Tshipise Basin that are correlated with the Permo-Carboniferous Dwyka and Ecca Groups of the Main Karoo Basin, and (3) thick Late Caenozoic alluvium along the banks of the Nzhelele River. The Madzaringwe and Mikambeni Formations of the Karoo succession mapped here are known elsewhere in Limpopo Province to contain thin coal seams associated with plant fossils of the *Glossopteris* Flora of Gondwana. The Late Caenozoic alluvium might contain local concentrations of fossils such as mammalian remains, non-marine molluscs and plant debris but scientifically important fossil material is likely to be very sparse.

Given that (1) the alluvial sediments within citrus orchard study areas are already highly disturbed by recent agricultural activity, (2) the potentially-fossiliferous Karoo bedrocks are probably not exposed at surface here, and (3) the development footprint is comparatively small (*c.* 200 ha), significant impacts on local palaeontological heritage resources due to the citrus orchard development are considered to be unlikely. No further specialist studies or mitigation for this project are recommended. The Chance Fossil Finds Protocol appended to this report should be applied by the landowner should any substantial fossil remains (*e.g.* vertebrate bones, teeth, petrified wood, plant fossil beds) be found in future when SAHRA should be notified immediately regarding possible mitigation (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 palaeontologist concerned with mitigation work would need a valid collection permit from SAHRA. All work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere to the minimum standards for Phase 2 palaeontological studies published by SAHRA (2013).

1. INTRODUCTION

1.1. Project outline and brief

Alicedale Estates (Pty) Ltd has undertaken the unauthorised cultivation of virgin veld in order to plant citrus trees on two separate areas with a total area of *c*. 200 ha on the farm Alicedale 138 MT, situated on the northern side of the R525 some 5 km southwest of Tshipise and *c*. 35 km WSW of Musina in the Vhembe District Municipality, Limpopo Province (Figs. 1 to 3).

Since the new citrus orchard development footprint overlies potentially fossiliferous sediments of the Karoo Supergroup, a desktop Palaeontological Assessment has been commissioned by G&A Heritage (Pty) Ltd, Louis Trichardt (Contact details: Mr Stephan Gaigher. G&A Heritage (Pty) Ltd. 38A Vorster Street, Louis Trichardt 0920. Cell: 073 752 6583. Tel: 015 516 1561. E-mail: stephan@gaheritage.co.za). to assess potential past impacts or proposed future mitigation regarding palaeontological heritage resources in the study area.

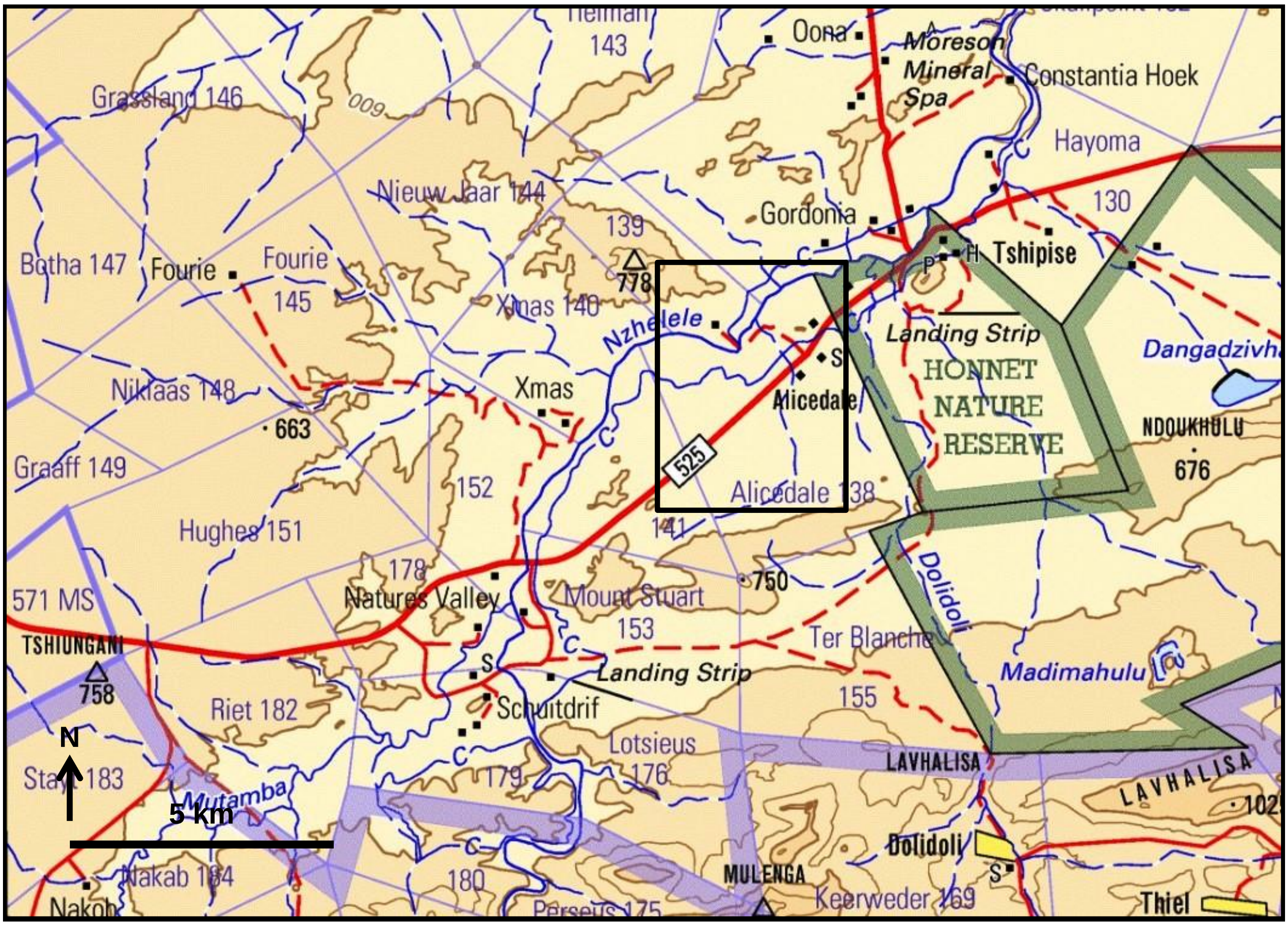

Figure 1. Extract from 1: 25 000 topographical sheet 2230 Musina (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the approximate location (black rectangle) of the citrus orchard project on the farm Alicedale138 MT near Tshipise, *c*. 35 km SSW of Musina in the Vhembe District, Limpopo Province.

1.2. Legislative context for palaeontological assessment studies

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

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

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

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

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

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

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

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

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

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

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

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

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

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

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

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

1.3. Approach to the desktop palaeontological heritage study

The approach to this desktop palaeontological heritage study is briefly as follows. Fossil bearing rock units occurring within the broader study area are determined from geological maps and satellite images. Known fossil heritage in each rock unit is inventoried from scientific literature, previous assessments of the broader study region, and the author's field experience and palaeontological database (See Table 1). Based on this data as well as field examination of representative exposures of all major sedimentary rock units present, the impact significance of the proposed development is assessed and recommendations for any necessary further studies or mitigation are made.

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations *etc.*) represented within the study area are determined from geological maps and satellite images. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author's field experience (consultation with professional colleagues as well as examination of institutional fossil collections may play a role here, or later following field assessment during the compilation of the final report). This data is then used to assess the palaeontological sensitivity of each rock unit to a development (Provisional tabulations of palaeontological sensitivity of all formations in the Limpopo Province have already been compiled by J. Almond and colleagues; *cf* Groenewald & Groenewald 2014).

The likely impact of the proposed development on local fossil heritage is then determined on the basis of (1) the palaeontological sensitivity of the rock units concerned, and (2) the nature and scale of the development itself, most significantly the extent of fresh bedrock excavation envisaged. When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a Phase 1 field assessment study by a professional palaeontologist is usually warranted to identify any palaeontological hotspots and make specific recommendations for any mitigation required before or during the construction phase of the development.

On the basis of the desktop and Phase 1 field assessment studies, the likely impact of the proposed development on local fossil heritage and any need for specialist mitigation are then determined. Adverse palaeontological impacts normally occur during the construction rather than the operational or decommissioning phase. Phase 2 mitigation by a professional palaeontologist – normally involving the recording and sampling of fossil material and associated geological information (*e.g.* sedimentological data) may be required (a) in the pre-construction phase where important fossils are already exposed at or near the land surface and / or (b) during the construction phase when fresh fossiliferous bedrock has been exposed by excavations. To carry out mitigation, the palaeontologist involved will need to apply for a palaeontological collection permit from the relevant heritage management authority (*e.g.* SAHRA for Limpopo Province). It should be emphasized that, *provided that appropriate mitigation is carried out*, the majority of developments involving bedrock excavation can make a *positive* contribution to our understanding of local palaeontological heritage.

1.4. Assumptions & limitations

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

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

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

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

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

5. Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:
(a) *underestimation* of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
(b) *overestimation* of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium *etc.*).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails *inferring* the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist. In the present case, site visits to the various loop and borrow pit study areas in some cases considerably modified our understanding of the rock units (and hence potential fossil heritage) represented there.

In the case of the Alicedale Farm project area near Tshipise, Limpopo Province, the main limitation for fossil heritage studies is the paucity of previous field-based specialist palaeontological studies in the Tshipise Karoo Basin, and indeed in the Limpopo Province as a whole. It is noted, for example, that HIAs for several major coal mining projects in the region north of the Soutpansberg (*e.g.* Chapudi Coal Project, Greater Soutpansberg Mopane Coal Project, Generaal Coal Project) do not have a palaeontological heritage component.

1.5. Information sources

The information used in this desktop study was based on the following:

1. Project outlines, kmz files and maps provided by G&A Heritage (See Gaigher 2018);

2. A review of the relevant scientific literature, including published geological maps and accompanying sheet explanations (*e.g.* Brandl 1981, Brandl 2002, Groenewald & Groenewald 2014) (Note that no relevant PIA reports for the region could be traced on SAHRIS);

3. Examination of relevant 1: 250 000 topographical maps and Google Earth© satellite images;

4. The author's previous field experience with the formations concerned and their palaeontological heritage.

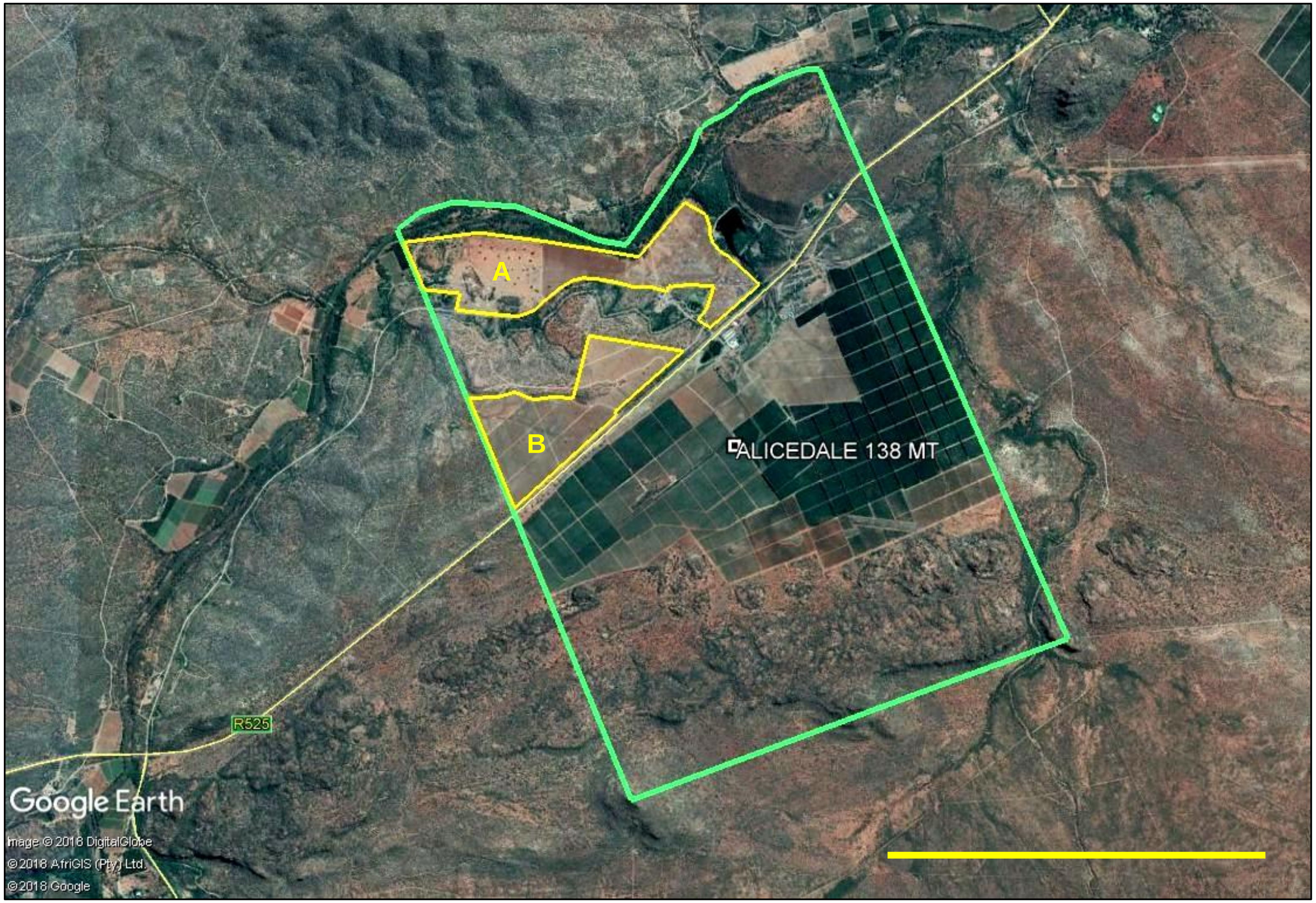

Figure 2. Google Earth© satellite image of the farm Alicedale 138MT (green polygon) as well as the two areas (A,B) that have been transformed for citrus cultivation. Scale bar = 3 km. N towards the top of the image.

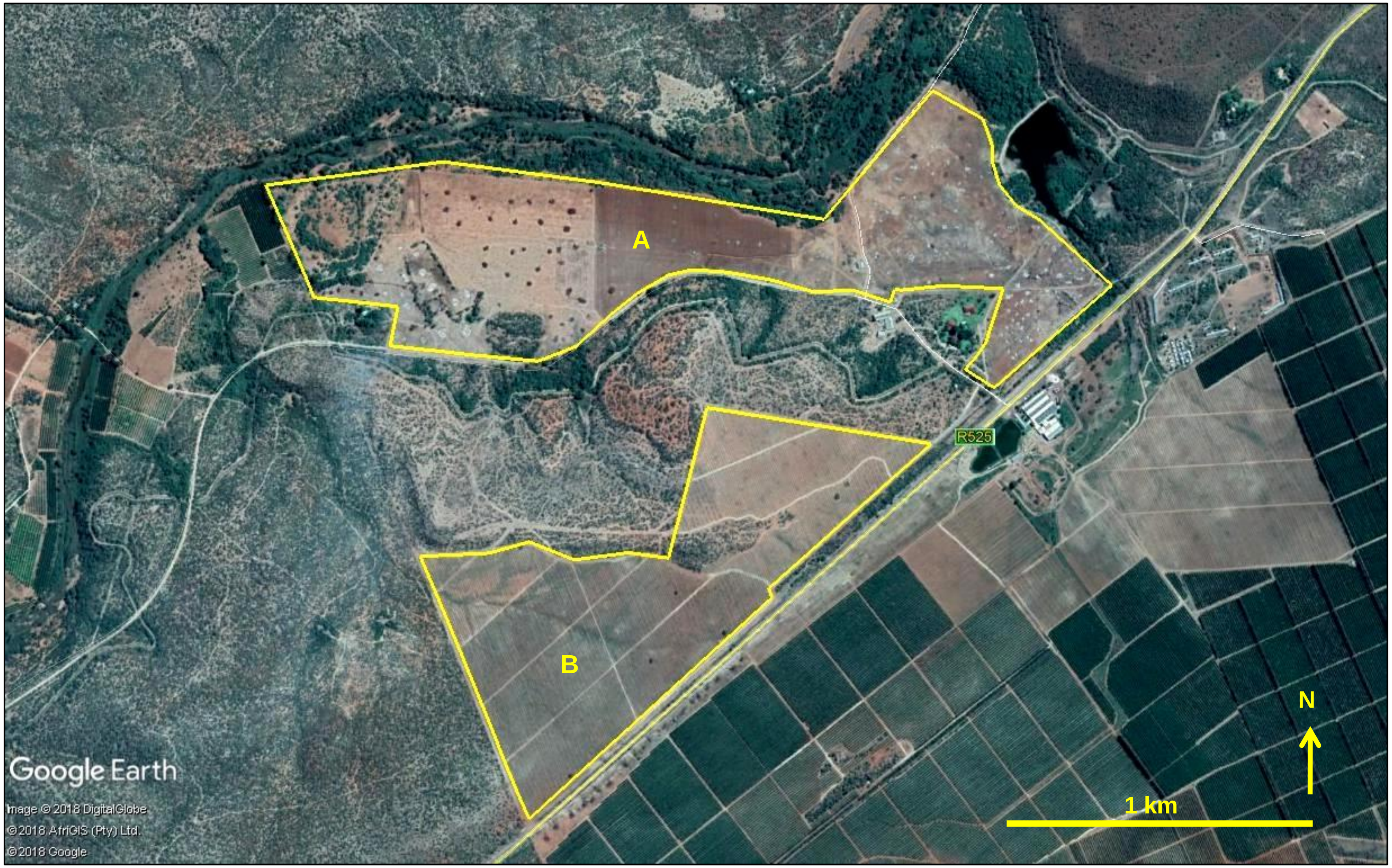

Figure 3. Google Earth© satellite image of the citrus orchard project area the farm Alicedale 138MT. Area A is approximately 120 hectares and Area B is approximately 80 hectares.

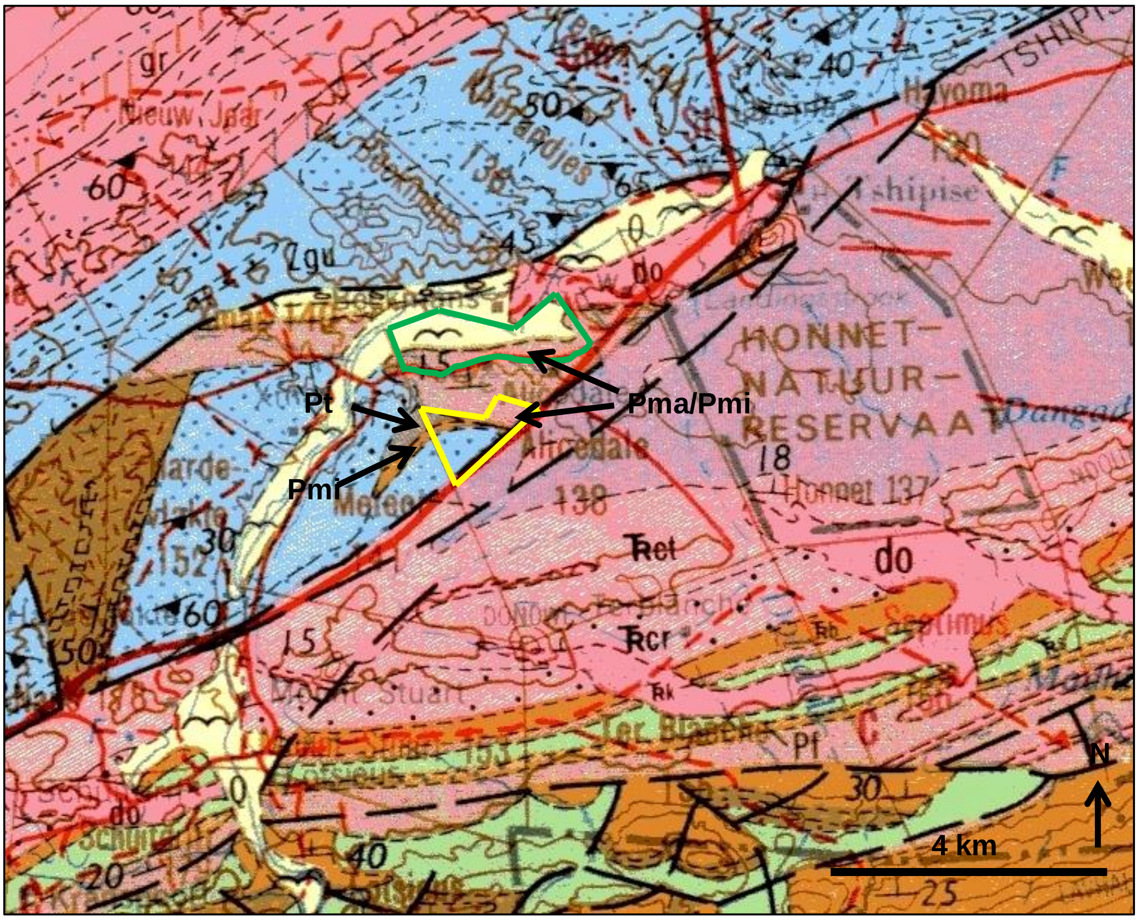

Figure 4. Extract from 1: 250 000 geology sheet 2230 Musina (Council for Geoscience, Pretoria) showing the approximate location of the citrus orchard developments on the farm Alicedale 138 MT near Tshipise, *c*. 35 km SSW of Musina in the Vhembe District, Limpopo Province. The main rock units represented within the project area include:

BEIT BRIDGE COMPLEX

- **Gumbu Group (Zgu, pale blue)**

KAROO SUPERGROUP

- **Tshidzi Formation (Pt, grey)**
- **Mikambeni Formation (Pmi, pale brown)**
- **Madzaringwe + Mikambeni Fms (Pma/Pmi, grey-brown)**

LATE CAENOZOIC SUPERFICIAL SEDIMENTS

- **Alluvium (pale yellow with flying bird symbol)**

2. GEOLOGICAL OUTLINE OF THE PROJECT AREA

The project area for the new citrus orchards on Farm Alicedale 138 MT, located c. 35 km WSW of Musina and 5 km SW of Tshipise, is situated along the southern banks of the Nzhelele River (a tributary of the Limpopo) and the R525 road between Mkhado and Tschipise (Fig. 1). The topographically subdued terrain here (*c*. 530 – 600 m amsl) is now occupied by agricultural or recently-cleared lands on the floodplain of the Nzhelele River and adjacent low hills, as shown by satellite images (Figs. 2 & 3) as well as field photos in the HIA report by Gaigher (2018). This low-relief region of Limpopo Province, situated to the north of the Soutpansberg Range, is referred to the Eastern Limpopo Flats Geomorphic Province by Partridge *et al.* (2010).

The geology of the broader project region is shown on 1: 250 000-scale geology sheet 2230 Messina published by the Council for Geoscience, Pretoria (Fig. 4), with an accompanying sheet explanation by Brandl (1981). The pronounced WSW-ENE structural grain terrain in the Eastern Limpopo Flats reflects that of the underlying 2000 Ma Limpopo Belt (Kramers *et al.* 2006). It features deformed and fault-found slivers of highly-metamorphosed basement rocks of the Archaean Beitbridge Complex, Proterozoic Soutpansberg Group sediments as well as small, downfaulted outliers of the Permian to Jurassic Karoo Supergoup. These last *plus* the overlying Early Jurassic Letaba Formation lavas (part of the Karoo Igneous Province) form part of the structurally complex Tshipise Basin of northern Limpopo Province (Johnson *et al.* 2006).

Calc-silicate rocks and marbles of the Archaean **Gumbu Group** (**Beit Bridge Complex**) mapped in the southern sector of the study area are highly metamorphosed and unfossiliferous basement lithologies that do not contain fossils (Kramers *et al.* 2006), so they are not considered further here.

Due to the structural complexity of the region, it is not quite clear exactly which bedrock units are present beneath the Alicedale Farm project area but it appears that small outcrop areas of several units of the lower **Karoo Supergroup** are mapped here – *viz.* the Tshidzi, Madzaringwe and Mikambeni Formations (Fig. 4). The stratigraphy of the Karoo succession in the Tshipise Basin is outlined by Johnson *et al.* (2006) (Fig. 5), based on earlier accounts by McCourt and Brandl (1980), Van der Berg (1980) and Brandl (1981). The most recent account by Bordy (2000) places these formations within an informal "Basal Unit" which is broadly correlated with the Dwyka and Ecca Groups of the Main Karoo Basin (Fig. 6). Levels of bedrock exposure in the Tshipise Basin are generally very poor, so much of the information on these Karoo beds is derived from borehole cores.

The basal **Tshidzi Formation** (Permo-Carboniferous Dwyka Group equivalent) (*c*. 5 to 20 m thick) unconformably overlies the basement rocks where it is preserved within isolated pre-Karoo depressions (Brandl 1981, Johnson *et al.* 2006, Bordy 2006). It is dominated by poorly-sorted diamictites (sandy to muddy matrix), breccias and conglomerates with subordinate grey laminated mudrocks. Direct evidence of a glacial deposition is lacking, so the diamictite facies might represent debrites or fluvio-glacial deposits rather than true tillites.

The Madzaringwe and Mikambeni Formations are generally correlated with the Permian Ecca Group of the Main Karoo Basin. The **Madzaringwe Formation**, up to 200 m in thickness, comprises interbedded shales, siltstones and feldspathic sandstone with a 30-50 m-thick, sandstone- to pebbly conglomerate-rich basal package of probable fluvial origin. The fine-grained middle portion of the succession (0-40m thick), best developed in the eastern outcrop area, contains carbonaceous shales and thin coals developed in a cool-climate peat swamp setting on meandering river floodplains. A thicker coal seam (up to 4 m) occurs within the upper part of the succession in the north-eastern outcrop area.

The **Mikambeni Formation** (up to 150 m thick) consists of massive mudrocks and shales with a few thin sandstone horizons towards the base and sideritic concretions towards the top. Thin coal bands may occur in the middle part of the succession which is interpreted as a shallow lacustrine to distal floodplain deposit.

The Karoo sedimentary succession in the Tshipise Basin was terminated by voluminous eruption of basaltic lavas of the **Letaba Formation** (**Lebombo Group**) which forms part of the Early Jurassic Karoo Igneous Province (*c*. 183 Ma; Duncan & Marsh 2006). The Letaba lavas crop out outside and to the east of the present study area towards Tshipise.

The Karoo bedrocks in the northern sector Alicedale study area are mantled by **Late Caenozoic alluvial deposits** along the banks of the Nzhelele River. Apart from mentioning that the alluvial deposits along this river may be "fairly thick", they are not described further by Brandl (1981). Disturbed sandy to gravelly alluvial soils are illustrated by Gaigher (2018) who also shows rubbly downwasted **surface gravels** in areas further from the river (*e.g.* overlying basement bedrocks in the south).

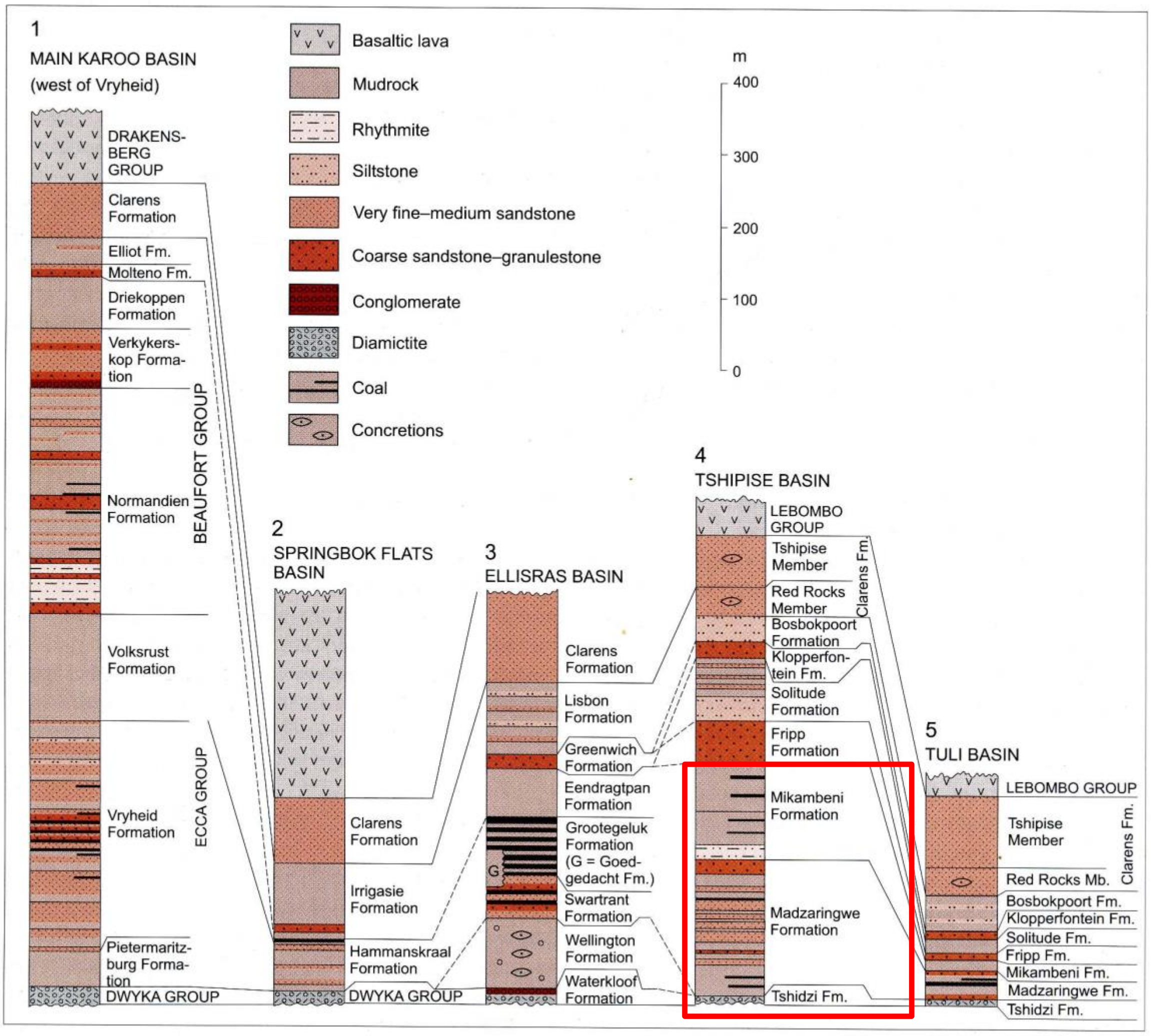

Figure 5. Lithostratigraphy of the Karoo Supergroup succession in the Tshipise Basin (column 4) and proposed correlations with other Karoo basins in the RSA (From Johnson *et al.* 2006). Rock units represented in the present study area are outlined in red and are broadly correlated with the Dwyka and Ecca Groups of the Main Karoo Basin of Southern Africa.

A. main Karoo Basin (Johnson, 1994)		1:250000 Geological Map Alldays, 2001	
"Stormberg Group"	Clarens Formation	Clarens Formation	Tshipise Sandstone Member
			Red Rocks Member
	Elliot Formation	Bosbokpoort Formation	
	Molteno Formation	Klopperfontein Formation	
Beaufort Group		Solitude Formation	
		Fripp Formation	
Ecca Group		Mikambeni Formation	
		Madzaringwe Formation	
Dwyka Group		Tshidzi Formation	

B. main Karoo Basin (Johnson, 1994)		Tshipise Basin (van der Berg, 1980)	Tuli Basin (Bordy, 2000)
"Stormberg Group"	Clarens Formation	Clarens Formation	Clarens Formation
	Elliot Formation	Solitude Formation	Upper Unit
	Molteno Formation	Joan Formation	Middle Unit*
		Fripp Formation	
Beaufort Group			
			Basal Unit
Ecca Group		Lilliput Formation	
Dwyka Group		Salaita Formation	
		Tshidzi Formation	

Figure 6. Stratigraphy and correlations of the Karoo Supergroup successions in the Tshipise and Tuli Basins of Limpopo Province (from Bordy 2006) with rock units represented in the present study area outlined in red.

3. PALAEONTOLOGICAL HERITAGE

Precambrian basement bedrocks of the Beit Bridge Complex are not palaeontologically sensitive, so they will not be treated further here. The palaeontology of the Karoo Supergroup sedimentary bedrocks represented in the Alicedale citrus farm project area is poorly known - as indeed is the palaeontology of the Limpopo Province as a whole. This reflects in part the lack of good bedrock exposures of the more readily-weathered Karoo Supergroup sediments, but also the paucity of field studies by palaeontologists - including impact specialists (The lack of PIAs for several major mining developments along the northern margins of the Soutpansberg is highly regrettable in this regard).

To the author's knowledge, no fossils have been recorded so far from the **Tshidzi Formation**, as might be expected for at least the coaser-grained glacially-related facies. However, by analogy with the Dwyka Group in the Main Karoo Basin, laminated mudrock horizons might contain interglacial or post-glacial assemblages of shelly invertebrates, trace fossils, drifted plant remains and microbiotas.

Thin to moderately thick (up to 4 m) swamp to lacustrine coal horizons within the Ecca–equivalent **Madzaringwe** and **Mikambeni Formations** contain fossil plants of the Gondwana Permian *Glossopteris* Flora, including glossopterids (*Glossopteris, Gamgamopteris* spp.), equisetalean ferns and organic-walled microfossils (*cf* Bordy 2006 and refs. therein, such as Truter 1945, Van Eeden *et al.* 1955). However, few details concerning these plant fossil assemblages are readily available in the scientific literature. It is noted that the sideritic concretions in the Mikambeni Formation might contain rich plant and animal fossil assemblages as well as well-preserved microfossils by analogy with the Euamerican Carboniferous Coal Measures.

The thick **Late Caenozoic alluvial deposits** along the Nzhelele River might contain a wide range of possible fossil or subfossil remains, though these are often sparse in younger alluvial sections. They may include, for example, mammalian bones, teeth and horncores, tortoise remains, ostrich eggshells, non-marine mollusc shells, ostracods, diatoms and other microfossil groups, trace fossils (*e.g.* calcretised termitaria, rhizoliths, burrows, vertebrate tracks), freshwater stromatolites as well as plant material such as peats, foliage, wood and pollens. Surface gravels away from the river are generally unfossiliferous.

To the author's knowledge, no fossil remains have been previously recorded within the present study area on Farm Alicedale 138MT. No relevant palaeontological impact assessments for developments involving the same bedrocks units in the region were located on the SAHRIS website.

4. CONCLUSIONS AND RECOMMENDATIONS

The citrus orchard project area on Farm Alicedale 138MT near Tshipise, Limpopo Province, is underlain by (1) unfossiliferous, highly-metamorphosed Precambrian basement rocks of the Beitbridge Complex, (2) small outcrop areas of Karoo Supergroup sediments of the Tshipise Basin that are correlated with the Permo-Carboniferous Dwyka and Ecca Groups of the Main Karoo Basin, and (3) thick Late Caenozoic alluvium along the banks of the Nzhelele River. The Madzaringwe and Mikambeni Formations of the Karoo succession mapped here are known elsewhere in Limpopo Province to contain thin coal seams associated with plant fossils of the *Glossopteris* Flora of Gondwana. The Late Caenozoic alluvium might contain local concentrations of fossils such as mammalian remains, non-marine molluscs and plant debris but scientifically important fossil material is likely to be very sparse.

Given that (1) the alluvial sediments within citrus orchard study areas are already highly disturbed by recent agricultural activity, (2) the potentially-fossiliferous Karoo bedrocks are probably not exposed at surface here, and (3) the development footprint is comparatively small (*c.* 200 ha), significant impacts on local palaeontological heritage resources due to the citrus orchard development are considered to be unlikely. No further specialist studies or mitigation for this project are recommended.

The Chance Fossil Finds Protocol appended to this report should be applied by the landowner should any substantial fossil remains (*e.g.* vertebrate bones, teeth, petrified wood, plant fossil beds) be found in future when SAHRA should be notified immediately regarding possible mitigation (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). This is so that appropriate mitigation (*i.e.* recording, sampling or collection) by a palaeontological specialist can be considered and implemented. Any new fossil material from the Karoo Supergroup beds in this region would be of considerable scientific interest. The palaeontologist concerned with mitigation work would need a valid collection permit from SAHRA. All work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere to the minimum standards for Phase 2 palaeontological studies published by SAHRA (2013).

5. ACKNOWLEDGEMENTS

Mr Stephan Gaigher of G&A Heritage (Pty) Ltd, Louis Trichardt, is thanked for commissioning this study and for providing the relevant background information as well as a useful series of field photographs from the project area.

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7. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

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

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

Declaration of Independence

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

John E. Almond

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

<table>
<tr><td colspan="3">APPENDIX: CHANCE FOSSIL FINDS PROCEDURE: New Citrus Orchards on the Farm Alicedale 138 MT near Tshipise.</td></tr>
<tr><td>Province & region:</td><td colspan="2">LIMPOPO PROVINCE, Vhembe District Municipality</td></tr>
<tr><td>Responsible Heritage Resources Authority</td><td colspan="2">SAHRA (Contact details: Dr Ragna Redelstorff, SAHRA, P.O. Box 4637, Cape Town 8000. Tel: 021 202 8651. Email: rredelstorff@sahra.org.za or Ms Natasha Higgitt. Tel: 021 462 4502. Email: nhiggitt@sahra.org.za)</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Tshidizi, Madzaringwe & Mikambeni Formations (Karoo Supergroup), Late Caenozoic alluvium</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Plant fossil beds in Karoo bedrocks, petrified wood or other plant material mammalian bones, teeth & horn cores in alluvial sediments</td></tr>
<tr><td rowspan="5">ECO protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
• Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
• Context – describe position of fossils within stratigraphy (rock layering), depth below surface
• Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
• Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation
• Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Authority for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
• Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
• Photograph fossils against a plain, level background, with scale
• Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
• Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
• Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Authority, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Authority</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Authority. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Authority minimum standards.</td></tr>
</table>