

RECOMMENDED EXEMPTION FROM FURTHER PALAEOLOGICAL STUDIES:

Proposed exploitation of fresh and weathered dolerite from four quarry sites near Sutherland, Namaqua District Municipality, Northern Cape

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EXECUTIVE SUMMARY

Given (1) the unfossiliferous nature of the target dolerite intrusions as well as (2) the inferred low palaeontological sensitivity of the adjacent baked country rocks of the Abrahamskraal Formation (Karoo Supergroup), it is recommended that exemption from further specialist palaeontological studies is granted for the proposed borrow pit and quarry developments on Farms Karreebosch 200, Rheeboeke Fontein 209 and Jakhals Valley 99 to the south of Sutherland.

Any substantial fossil remains (e.g. vertebrate bones and teeth, shells, petrified wood) encountered during excavation should be reported to SAHRA for possible mitigation by a professional palaeontologist (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).

1. OUTLINE OF PROPOSED DEVELOPMENTS

The company Power Construction (Pty) Ltd is proposing to exploit dolerite from four sites between Sutherland and Matjiesfontein, Namaqua District Municipality, Northern Cape. The sites comprise three “soft rock” borrow pits to be excavated into weathered dolerite as well as one “hard rock” quarry where fresh dolerite will be excavated. The materials excavated from the soft rock sites will be utilised for the construction and maintenance of gravel access roads and wind turbine platforms as part of several planned wind energy facilities in the region while the fresh dolerite from the hard rock quarry will provide aggregate and crushed sand for concrete production.

The four study sites are as follows (Figs. 7 to 9):

1. **R354 Borrow Pit** (4.519 ha) on Farm Karreebosch 200 Portion 1, located c. 44 km to the south of Sutherland (Fig. 7).
2. **Karusa North Borrow Pit** (4.945 ha) on Farm Rheeboeke Fontein 209 Remainder, located c. 52 km south of Sutherland (Fig. 8).
3. **Karusa East Borrow Pit** (4.981 ha) on Farm Rheeboeke Fontein 209 Portion 2 and 209 Portion 3, located c. 55 km south of Sutherland (Fig. 8).
4. **Sutherland quarry** (4.95 ha) on Farm Jakhals Valley 99 Portion 3, located c. 5.8 km south of Sutherland (Fig. 9).

This combined palaeontological heritage assessment comment for the proposed quarry developments near Sutherland was commissioned by Site Plan Consulting (Contact details: Jaques van der Vyver. Tel No: 021 854 4260; Fax No: 021 854 4321; E-mail address:

Jaques@siteplan.co.za) as part of a comprehensive HIA by the Agency for Cultural Resource Management, ACRM (Contact details: Jonathan Kaplan. Address: 5 Stuart Road, Rondebosch. P/F: 021 685 7589. M: 082 321 0172. Email: acrm@wcaces.co.za). The report contributes to the Environmental Impact Assessment (EIAs) and corresponding Environmental Management Programmes (EMPrs) for the four separate projects.

1.1. Legislative context

This report falls under Sections 35 and 38 (Heritage Resources Management) of the South African Heritage Resources Act (Act No. 25 of 1999), and it will also inform the Environmental Management Plan for this project.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

2. GEOLOGICAL BACKGROUND

The geological settings for each of the proposed quarry sites are shown in Figs.7 to 9, abstracted from the relevant Scoping Reports prepared by Site Plan Consulting (October - November, 2015) and based on the 1: 250 000 geology sheet 3220 Sutherland (Council for Geoscience, Pretoria) (Theron 1983). The three proposed “soft rock” borrow pits are all to be excavated into 10-20 m wide, subvertically-orientated dolerite dykes that form part of a narrow NW-SE trending dyke swarm of the Early Jurassic **Karoo Dolerite Suite**. The dykes at surface are composed of deeply-weathered to friable “sugar dolerite” (also known as *sabunga* in the Eastern Cape) (Figs. 2 & 3) that gives way to mixed weathered dolerite and corestones and then to fresh dolerite at 3-4 m beneath the surface. The dolerite swarm and adjacent baked country rocks within the Karusa Wind Energy Facility study area were briefly examined on **Rheebokke Fontein 209** by Almond (2015) (Fig. 1).

The dolerite dykes and sill to be exploited during quarrying are intruded into potentially fossiliferous continental sediments of the **Abrahamskraal Formation** (Adelaide Subgroup, Lower Beaufort Group, Karoo Supergroup) that are Middle Permian in age (Johnson *et al.* 2006). These fluvial successions and the associated minor intrusive rocks have been briefly described for the Kareebosch and Karusa Wind Energy Facility study areas within which the three “soft rock” borrow pit sites lie (Almond 2014, Almond 2015a, with extensive references therein).

The dolerite hard rock quarry will be excavated into a major dolerite sill, over 20 m thick, that spans the R354 at Rooikloof to the south of Sutherland (Fig. 4). This sill has already been exploited in a number of hard rock quarries in the immediate area. Giant rounded dolerite corestones as well as good contacts with tough, baked country rocks (hornfles, quartzites) of the Abrahamskraal Formation are well exposed in road cuttings along the R354 east of the quarry study area (Figs. 5 & 6).

3. PALAEOLOGICAL HERITAGE

The Karusa North and Karusa East borrow pit sites fall within the study area for the Karusa Wind Energy Facility while the R354 borrow pit lies within the Kareebosch Wind Farm project area. The potentially fossiliferous Middle Permian country rocks of the Abrahamskraal Formation have been studied recently in these two areas by Almond (2015a) and Almond (2014) respectively. In both cases, the only fossil remains recorded comprised low diversity invertebrate trace fossil assemblages, fragmentary compressions and casts of reedy plants (horsetails) and rare fossil wood impressions, while no significant vertebrate fossils were seen. It was concluded that the palaeontological sensitivity of both these areas is low. Higher-lying beds of the Abrahamskraal Formation in the Rooikloof area south of Sutherland are likely to contain sparse vertebrate fossil remains (*e.g.* therapsids) (Almond 2015b, fossil distribution maps and refs. therein) but these will not be directly impacted by the proposed dolerite quarry.

The dolerite target outcrops in the borrow pit and quarry study areas are in themselves of no direct palaeontological significance since these are high temperature igneous rocks emplaced at depth within the Earth’s crust. However, as a consequence of their proximity to large dolerite intrusions, the Lower Beaufort Group sediments nearby may well have been thermally metamorphosed or “baked” (*ie.* recrystallised, impregnated with secondary minerals). Fossil material of phosphatic composition embedded within the country rocks, such as bones and teeth, is frequently altered by baking – bones may become blackened, for example - and can be very difficult to extract from the hard matrix by mechanical preparation (Smith & Keyser, p. 23 *in* Rubidge 1995). Thermal metamorphism by dolerite intrusions therefore tends to reduce the palaeontological heritage potential of adjacent Karoo Supergroup sediments.



Fig. 1. NW-SE striking dolerite dyke (c. 2.5 m thick) intruding, and slightly displacing, Abrahamskraal Formation country rocks, stream cutting on Rheebokke Fontein 209. The dyke weathers prominently as a blocky-jointed ridge (Image taken from Almond 2015a).



Fig. 2. Deeply-weathered, friable dolerite exposed in the walls of an existing trench-like borrow pit on Farm Karreebosch 200 (R354 borrow pit site).



Fig. 3. Contact between the weathered dolerite dyke (brownish rock on RHS) and the dark grey baked country rocks of the Abrahamskraal Formation (LHS) (R354 borrow pit site).



Fig. 4. Surface exposure of the massive dolerite sill on the western side of the R354 at Rooikloof, south of Sutherland (Farm Jakhals Valley 99).



Fig. 5. R354 road cutting through the massive sill at Rooikloof showing the sharp lower contact with baked channel sandstones of the Abrahamskraal Formation as well as typical rusty-brown lateritic and corestone weathering of the dolerite body itself (Hammer = 30 cm).



Fig. 6. Huge rounded corestone of fresh dolerite suspended in friable, rusty-brown sugary dolerite or *sabungung*, R354 road cutting at Rooikloof.

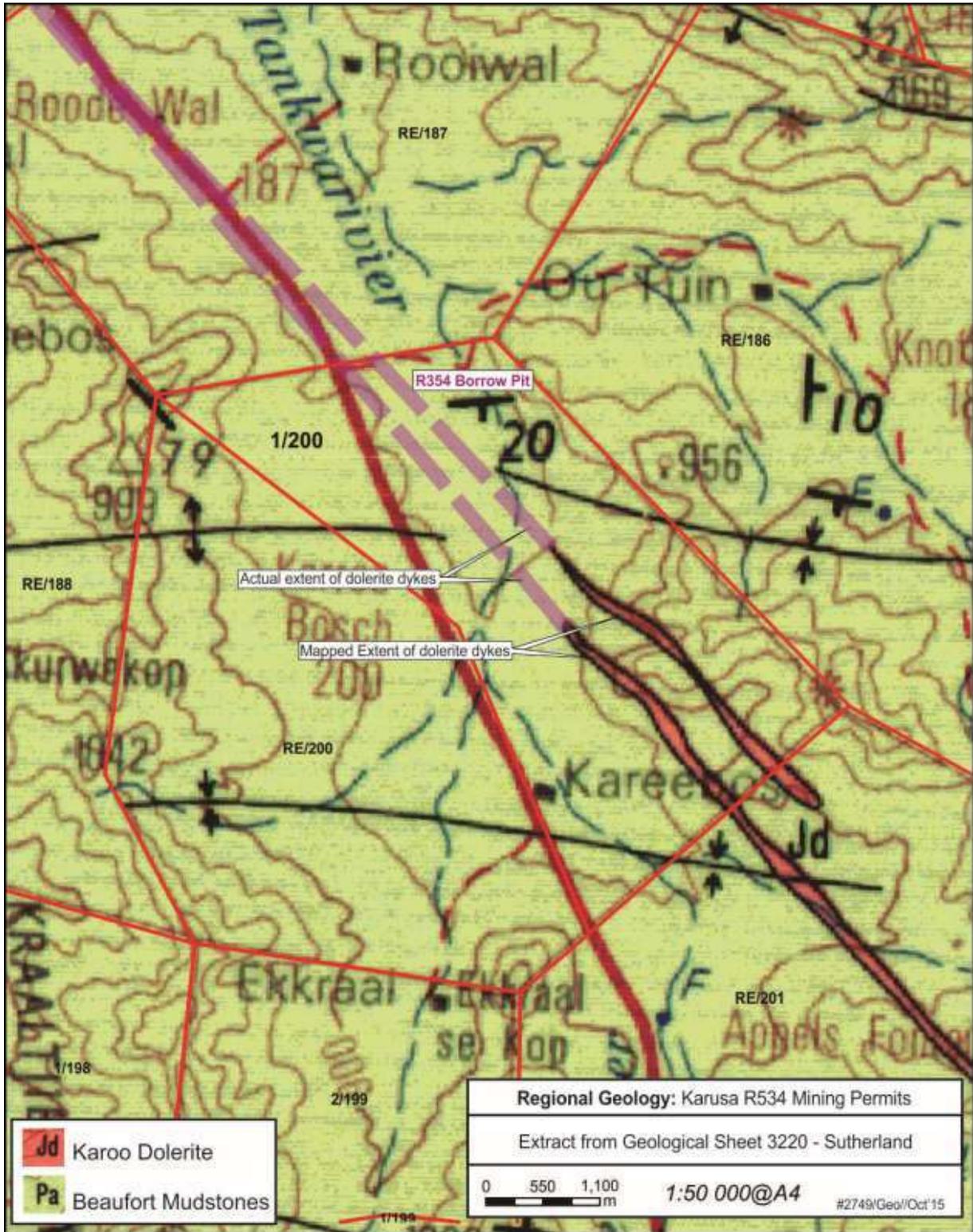


Fig. 7. Geological setting of the R354 borrow pit on Farm Karreebosch 200 Portion 1 based on the 1: 250 000 geology sheet 3220 Sutherland (Council for Geoscience, Pretoria) (Image abstracted from the Scoping Report by Site Plan Consulting (Nov., 2015).

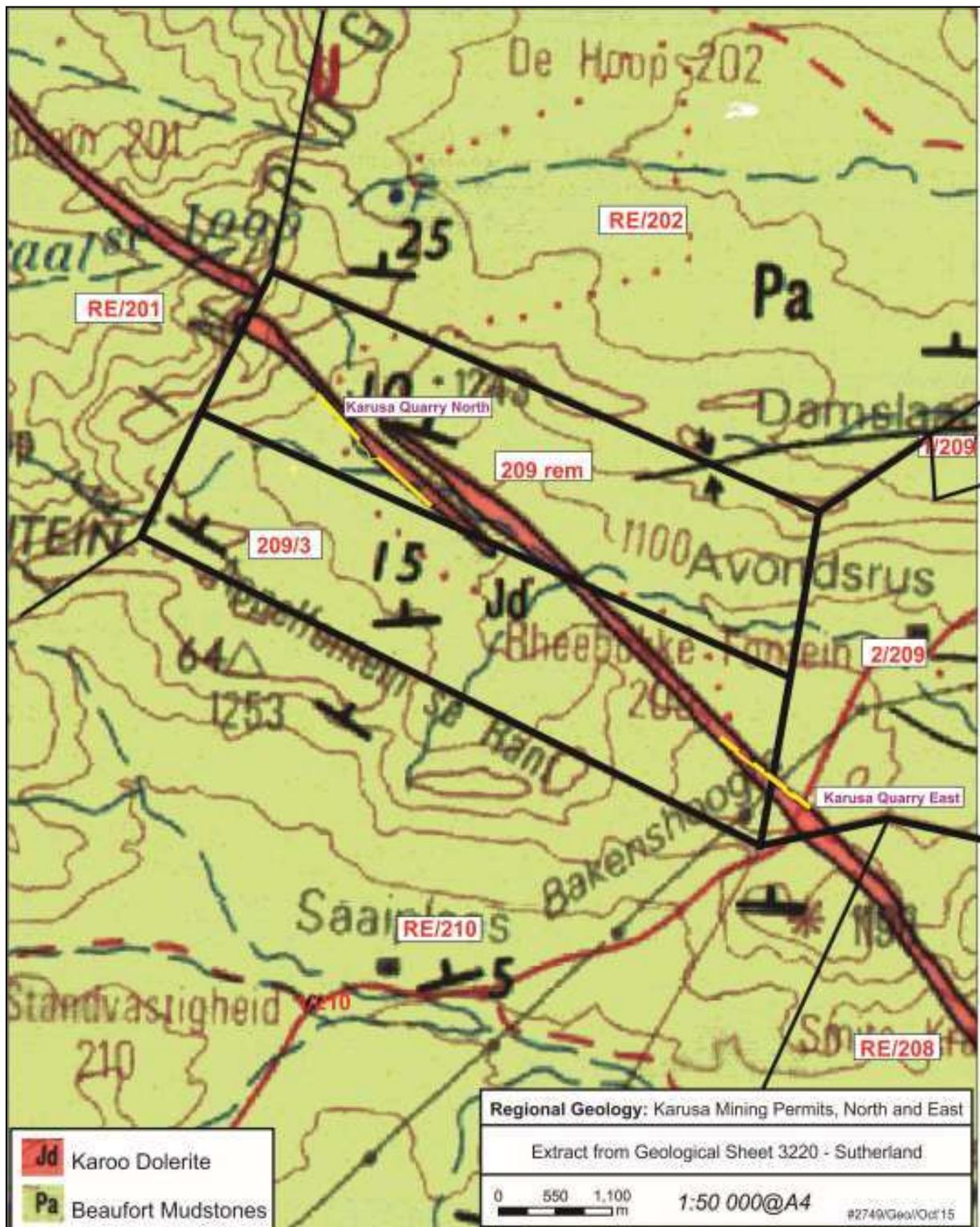


Fig. 8. Geological setting of the Karusa North and Karusa East borrow pits (yellow lines) on Farm Rheebokke Fontein 209 based on the 1: 250 000 geology sheet 3220 Sutherland (Council for Geoscience, Pretoria) (Image abstracted from the Scoping Report by Site Plan Consulting (Nov., 2015).

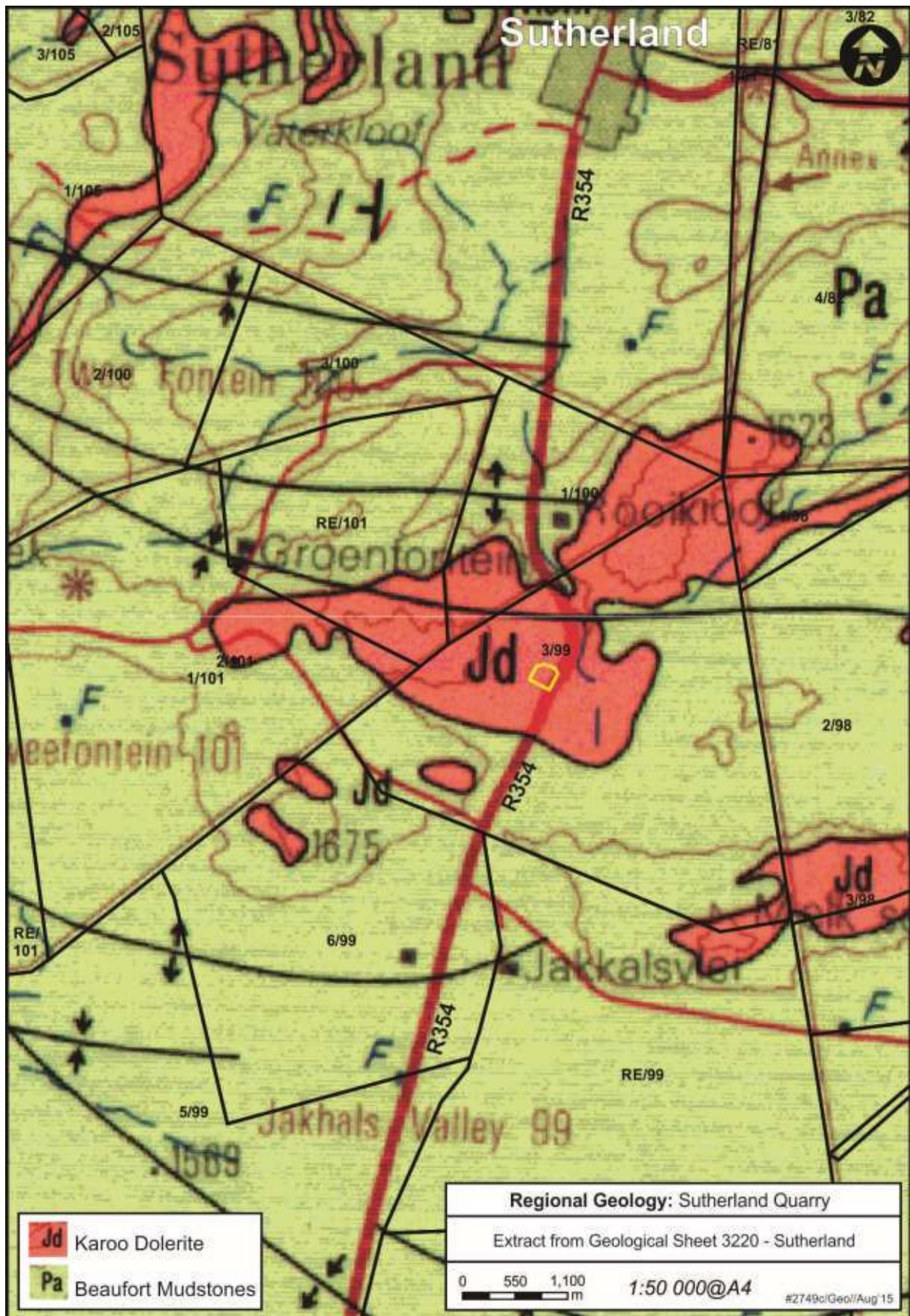


Fig. 9. Geological setting of the Sutherland quarry (yellow polygon) on Farm Jakhals Valley 99 Portion 3 based on the 1: 250 000 geology sheet 3220 Sutherland (Council for Geoscience, Pretoria) (Image abstracted from the Scoping Report by Site Plan Consulting (Nov., 2015).

4. CONCLUSIONS & RECOMMENDATIONS

All the proposed borrow pit and quarry developments will be targeting dolerite intrusions that are in themselves of no palaeontological sensitivity. Country rocks of the Abrahamskraal Formation (Lower Beaufort Group, Karoo Supergroup) adjacent to the three borrow pit sites are of low palaeontological sensitivity, as determined from recent palaeontological heritage assessments in the area (Almond 2014, 2015a). Baking of the country rocks during dolerite intrusion has probably further reduced their palaeontological sensitivity.

It is therefore recommended that exemption from further specialist palaeontological studies is granted for the proposed borrow pit and quarry developments on Farms Karreebosch 200, Rheeboeke Fontein 209 and Jakhals Valley 99 to the south of Sutherland.

Any substantial fossil remains (e.g. vertebrate bones and teeth, shells, petrified wood) encountered during excavation should be reported to SAHRA for possible mitigation by a professional palaeontologist (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).

5. REFERENCES

ALMOND, J.E. 2005. Palaeontological scoping report: Proposed golf estate, Sutherland, Northern Cape, 10 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2011. Proposed photovoltaic solar energy facility on the farm Jakhals Valley (RE/99) near Sutherland, Karoo Hoogland Municipality, Northern Cape Province. Palaeontological specialist study: combined desktop and field assessment, 34 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2014. Proposed Karreebosch Wind Farm (Roggeveld Phase 2) near Sutherland, Northern Cape Province. Palaeontological heritage assessment: combined desktop & field-based study, 65 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015a. Authorised Karusa Wind Farm near Sutherland, Namaqua District Municipality, Northern Cape Province. Palaeontological heritage assessment: combined desktop & field-based study, 57 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015b. Proposed Gunstfontein Wind Energy Facility near Sutherland, Karoo Hoogland Local Municipality, Northern Cape Province. Palaeontological heritage assessment: combined desktop & field-based study, 62 pp. Natura Viva cc, Cape Town.

DUNCAN, A.R. & MARSH, J.S. 2006. The Karoo Igneous Province. Pp. 501-520 in Johnson. M.R., Anhaeusser, C.R. & Thomas, R.J. (eds.) The geology of South Africa. Geological Society of South Africa, Johannesburg & the Council for Geoscience, Pretoria.

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

RUBIDGE, B.S. (Ed.) 1995. Biostratigraphy of the Beaufort Group (Karoo Supergroup). 46pp. South African Committee for Stratigraphy, Biostratigraphic Series No. 1. Council for Geoscience, Pretoria.

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

THERON, J.N. 1983. Die geologie van die gebied Sutherland. Explanation of 1: 250 000 geological Sheet 3220, 29 pp. Council for Geoscience, Pretoria.

6. 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, Free State, Mpumalanga and Northwest Province under the aegis of his Cape Town-based company *Natura Viva cc*. He was 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.



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