

Phase 1 Palaeontological Impact Assessment of four
borrow pits along the Madonisi and Masimini access
roads near Mthatha, EC Province.



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Executive Summary

- A Palaeontological Impact Assessment was carried out at four borrow pit sites earmarked for the rehabilitation of the Masimini – Madonsini access roads located near the N2 national road, about 30 km southwest of Mtatha in the Eastern Cape Province.
- Borrow Pit 1 and 2 are exclusively doleritic, being located on an interconnected network of dolerite sills. The superficial sediments in and around the borrow pit areas are also not fossiliferous. There is currently no record of Quaternary palaeontological exposures in the vicinity.
- Borrow Pit 3 is underlain by a network of dolerite dykes and is, together with the superficial sediments in and around the site, also not palaeontologically significant.
- Borrow Pit 4 is an existing quarry cut into dolerite outcrop that is capped by up to 3 m of yellow-grey sandstone and metasediments.
- No fossils or trace fossils were observed in the sedimentary exposures that were accessible during the survey of Borrow Pit 4.
- Given the size of the affected area at Borrow Pit 4, the likelihood that objects of palaeontological significance may be uncovered during the course of excavation activities into intact sedimentary bedrock is low, but in the event of a fossil discovery it is advised that SAHRA, ECPHRA and a professional palaeontologist are informed right away.

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Introduction

At the request of Control Civil Services, a Palaeontological Impact Assessment was carried out at four borrow pit sites that will be used to rehabilitate the Masimini – Madonsini access roads located near the N2 national road, about 30 km southwest of Mtatha in the Eastern Cape Province (**Fig. 1 & 2**). The survey is required as a prerequisite for new development in terms of the National Environmental Management Act and is also called for in terms of the National Heritage Resources Act 25 of 1999. In terms of Section 38 of the National Heritage Resources Act 25 of 1999 the survey is required as a prerequisite for any development which will change the character of a site exceeding 5 000 m² in extent. According to the SAHRA Fossil Sensitivity Map the sites are located in an area considered to be highly sensitive especially with regard to the palaeontology of the Beaufort Group and as such require a field assessment and protocol for subsequent fossil discoveries.

A site visit and subsequent assessment took place in May 2014. The task involved identification of possible paleontological sites or occurrences in the proposed zone, an assessment of their significance, related impact by the proposed development and recommendations for mitigation where relevant.

Description of the Affected Area

Locality data

1 : 50 000 scale topographic map: 3128DC Elliotdale

1 : 250 000 scale geological map: 3128 Umtata

Site coordinates of each borrow pit are presented as reference points in **Table 1**. All the sites except Borrow Pit 1 are old borrow pits (**Fig 3 & 4**).

Geology

The area around Borrow Pits 1 and 2 is underlain by Late Permian Adelaide Subgroup (*Pa*, Beaufort Group) strata, but they are difficult to separate due to poor exposures in the region (**Fig. 5**) (Karpeta and Johnson 1979; Johnson 2006). The area around Borrow Pits 3 and 4 is underlain by Early Triassic Tarkastad Subgroup strata (Beaufort Group) represented by the Katberg Formation (*Trk*). Geologically recent (Quaternary) alluvial deposits and reworked colluvial sediments cover the older rocks in places (*flying bird symbol*). The Katberg Formation is characterised by thick

horizons of yellowish–grey to light greenish–grey sandstones with subordinate bluish–grey and reddish–grey mudstones (Karpeta and Johnston 1979). The sedimentary sequence has been intruded by dykes, inclined sheets and sills of Jurassic-age dolerite. Dykes are up to 10 m wide and several kilometres wide. Sills are often formed as undulating or fanning basins varying in thickness from less than 1 metre to over 100 meters.

Palaeontological Background

Regarded as of high overall palaeontological significance, the Adelaide Subgroup (*Pa*) sediments in the region and the Katberg Formation strata (*Trk*) are assigned to the *Dicynodon* and *Lystrosaurus* Assemblage Zones respectively (**Fig. 6**), which represent two out of eight biostratigraphic markers that represent the evolution of Permian and Triassic mammal-like reptiles, and the evolutionary transition to mammals in the Beaufort Group (Groenewald and Kitching 1995; Kitching 1977, 1995).

The *Dicynodon* AZ is characterized by the presence of both the therapsids *Dicynodon* and *Theriongnathus*. Therapsid fossils are normally well-preserved in mudrock horizons and are usually found as dispersed isolated specimens associated with an abundance of calcareous nodules. Fish fossils (*Atherstonia scutata*) and plant fossils such as *Dadoxylon* and *Glossopteris* also occur.

The *Lystrosaurus* AZ is characterized by an abundance of *Lystrosaurus* in association with *Procolophon* and the absence of *Dicynodon lacerticeps*. Other common genera include *Moschorhinus*, *Proterosuchus* and *Lydekkerina*. Vertebrate fossils are primarily found in mudrock sequences between channel sandstones. Casts of large burrows and trace fossils have also been described from several localities within this biozone. Plant fossils include *Dadoxylon*, *Glossopteris* and *Schizoneura*.

Dolerite (*Jd*), which includes a wide range of petrological facies in the form of dykes, sills and inclined sheets (Duncan and Marsh 2006), are not palaeontologically significant, but fossils can occur in the contact metamorphic zone adjacent to the dolerite intrusions .

Quaternary palaeontological sites are occasionally found in Pleistocene alluvial terraces and dongas along rivers and streams. Quaternary alluvial deposits, especially near water courses and drainage lines, have the potential to yield microfossil and large mammal fossil remains.

Field Assessment

Methodology

A pedestrian survey involved an investigation of the surroundings along each pit margin, and the exposures inside each pit where visible. A Garmin Etrex Vista GPS hand model (set to the WGS 84 map datum) and a digital camera, were used to record relevant data. Relevant palaeontological information was assimilated for the report and integrated with data acquired during the on-site inspection.

Results

All four borrow pits are easily accessible, being directly accessible from the road. Borrow Pit 1 and 2 are exclusively doleritic, being located on an interconnected network of dolerite sills (**Figs. 7 - 10**). The dolerite bedrock is not palaeontologically significant. The superficial sediments in and around the borrow pit areas are also not fossiliferous. There is currently no record of Quaternary palaeontological exposures in the vicinity.

Borrow Pit 3 is underlain by a network of dolerite dykes and is, along with the superficial sediments in and around the site, also not palaeontologically significant (**Fig. 11 & 12**). Borrow Pit 4 is an existing quarry cut into dolerite outcrop (sill) that is capped by up to 3 m of yellow-grey sandstone and metasediments (**Fig. 13 & 14**). No fossils or trace fossils were observed in the sedimentary exposures that were accessible during the survey of Borrow Pit 4. There is currently no record of Quaternary palaeontological exposures in the vicinity.

Impact Statement

Borrow Pits 1, 2 and 3 are primarily underlain by intrusive igneous dolerites. Dolerites are not fossiliferous and can be excluded from further consideration in the present assessment. The sedimentary outcrop at Borrow Pit 4 will be impacted by excavations and ground moving activities if the pit is extended, but potential palaeontological impact is considered low to moderate since the mode of occurrence for fossils in the *Lystrosaurus* AZ is primarily restricted to the mudrock sequences between the channel sandstones.

In general, the discovery of otherwise unobservable fossil material as a result of excavation activities could be beneficial to the scientific community and could be seen as a positive palaeontological impact.

Recommendations

There are no major palaeontological grounds to halt development of the sites. No further mitigation is required for the proposed borrow pit sites. Given the size of the affected area at Borrow Pit 4, the likelihood that objects of palaeontological significance may be uncovered during the course of excavation activities into intact sedimentary bedrock is low, but in the event of a fossil discovery it is advised that SAHRA, ECPHRA and a professional palaeontologist are informed right away.

References

- Duncan, A.R. and Marsh, J.S. 2006. *The Karoo Igneous Province*. **In:** M.R. Johnson, *et. al.* (eds). The Geology of South Africa. Geological Society of South Africa.
- Groenewald, G.H. and Kitching, J.W. 1995. Biostratigraphy of the Lystrosaurus AZ. **In:** B.S. Rubidge, *Biostratigraphy of the Beaufort Group*. Biostrat. Ser. S.Afr. Comm. Strat. 35 – 39.
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- Rubidge, B. S. 1995. (ed) *Biostratigraphy of the Beaufort Group*. Biostrat. Ser. S.Afr. Comm. Strat. 1, 1 – 45.

Tables and Figures

Table 1. Site coordinates of the study areas.

Locality	Point	Coordinates
BP 1	A	31°49'54.03"S 28°39'40.46"E
	B	31°49'54.03"S 28°39'43.42"E
	C	31°49'57.93"S 28°39'43.26"E
	D	31°49'57.78"S 28°39'38.71"E
BP 2	A	31°49'51.61"S 28°39'41.76"E
	B	31°49'51.99"S 28°39'44.39"E
	C	31°49'53.78"S 28°39'44.07"E
	D	31°49'53.79"S 28°39'40.53"E
BP 3	A	31°48'38.86"S 28°33'8.80"E
	B	31°48'38.72"S 28°33'13.55"E
	C	31°48'41.17"S 28°33'13.58"E
	D	31°48'41.11"S 28°33'8.61"E
BP 4	A	31°49'13.37"S 28°33'12.49"E
	B	31°49'17.96"S 28°33'18.46"E
	C	31°49'20.13"S 28°33'15.46"E
	D	31°49'15.99"S 28°33'9.67"E

Table 2. Potential fossil heritage within geological units present in the region.

Geological Unit		Predominant rock types and Age	Previously recorded fossil heritage
Superficial sediments	Alluvium Colluvium	Quaternary	Large mammal bones, horn cores and dentition, coprolites, pollen, phytoliths, terrestrial gastropods (Florisian LMA)
Karoo Dolerite Suite	Intrusive feature	Igneous dolerite (<i>Jd</i>) Jurassic	Not fossiliferous
Beaufort Group	Tarkastad Subgroup Katberg Frm. (<i>Trk</i>)	Fluvial and lacustrine mudstones and sandstones. Early Triassic	<i>Lystrosaurus</i> Assemblage Zone
	Adelaide Subgroup (<i>Pa</i>)	Fluvial and lacustrine mudstones and sandstones. Late Permian	<i>Dicynodon</i> Assemblage Zone

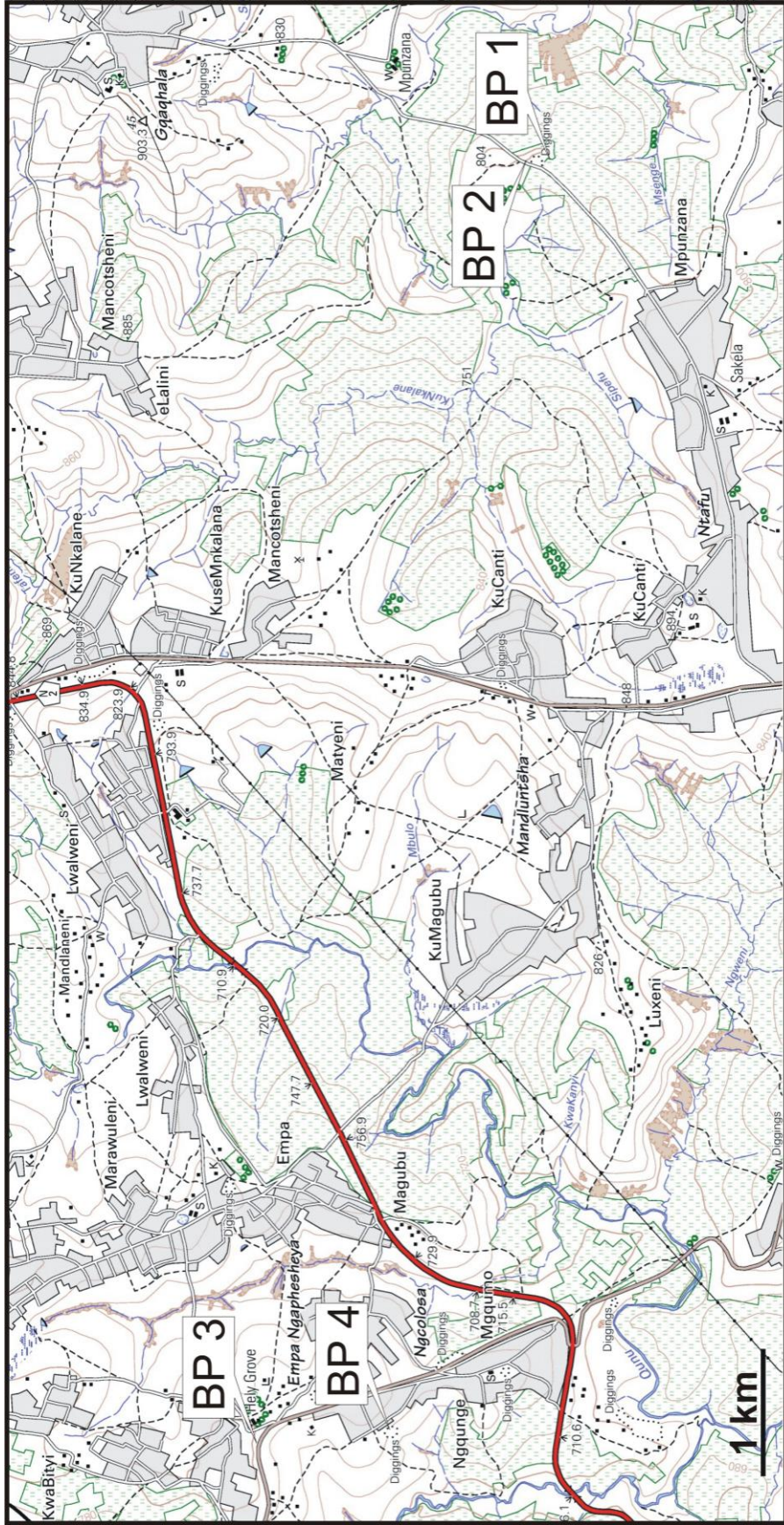


Figure 1. Locality map of the four borrow pit sites (portion of 1:50 000 scale topographic map 3128DC Elliotdale).

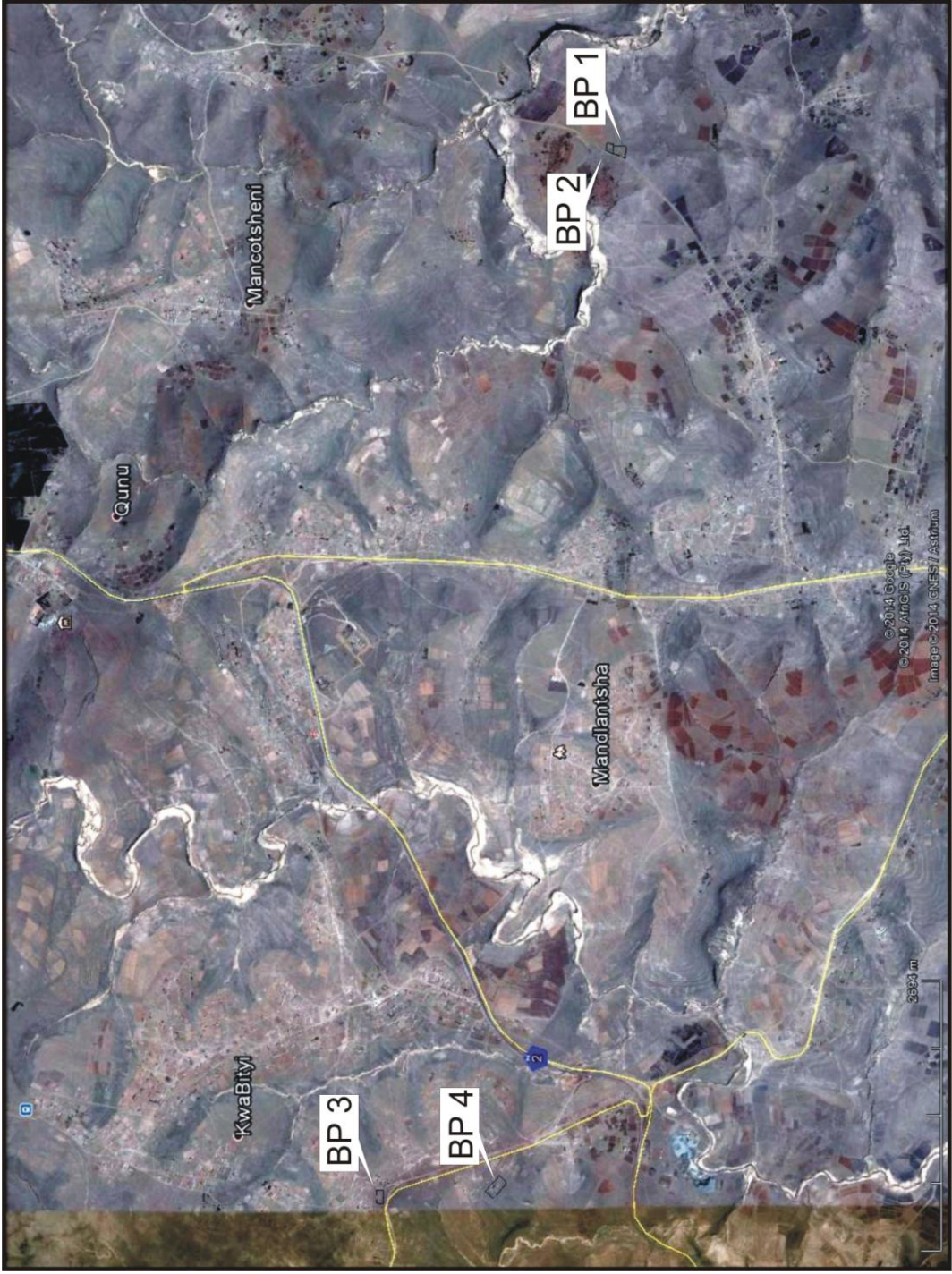


Figure 2. Aerial view of the four study areas.



Figure 3. Layout of Borrow Pit 1 and 2.

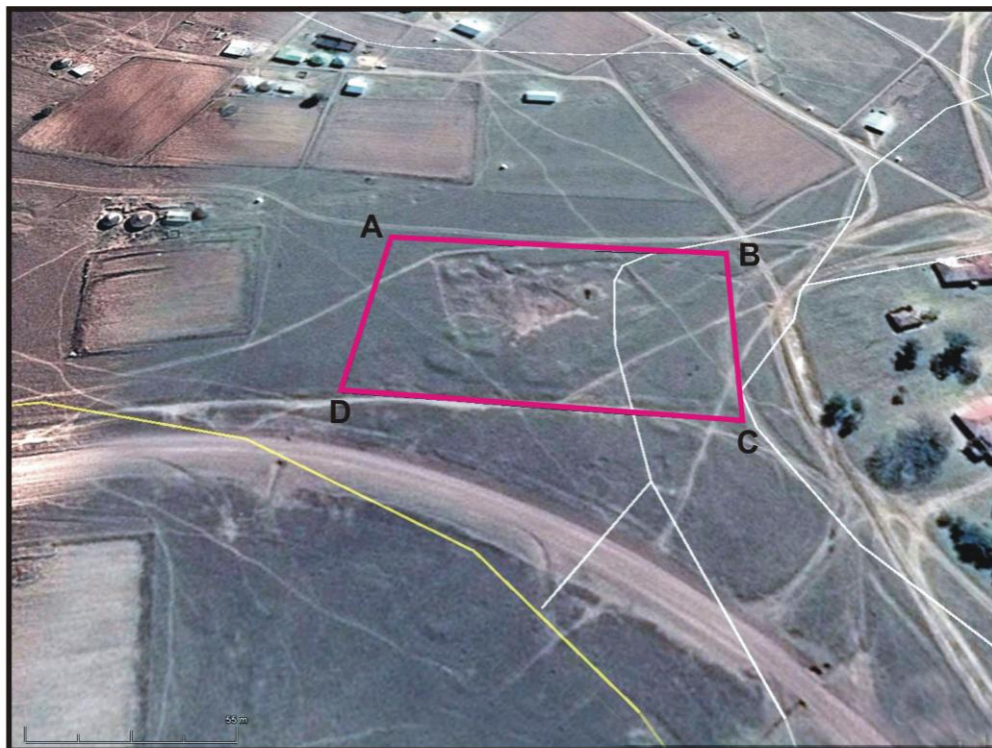


Figure 4. Layout of Borrow Pit 3 (above) and Borrow Pit 4 (below).

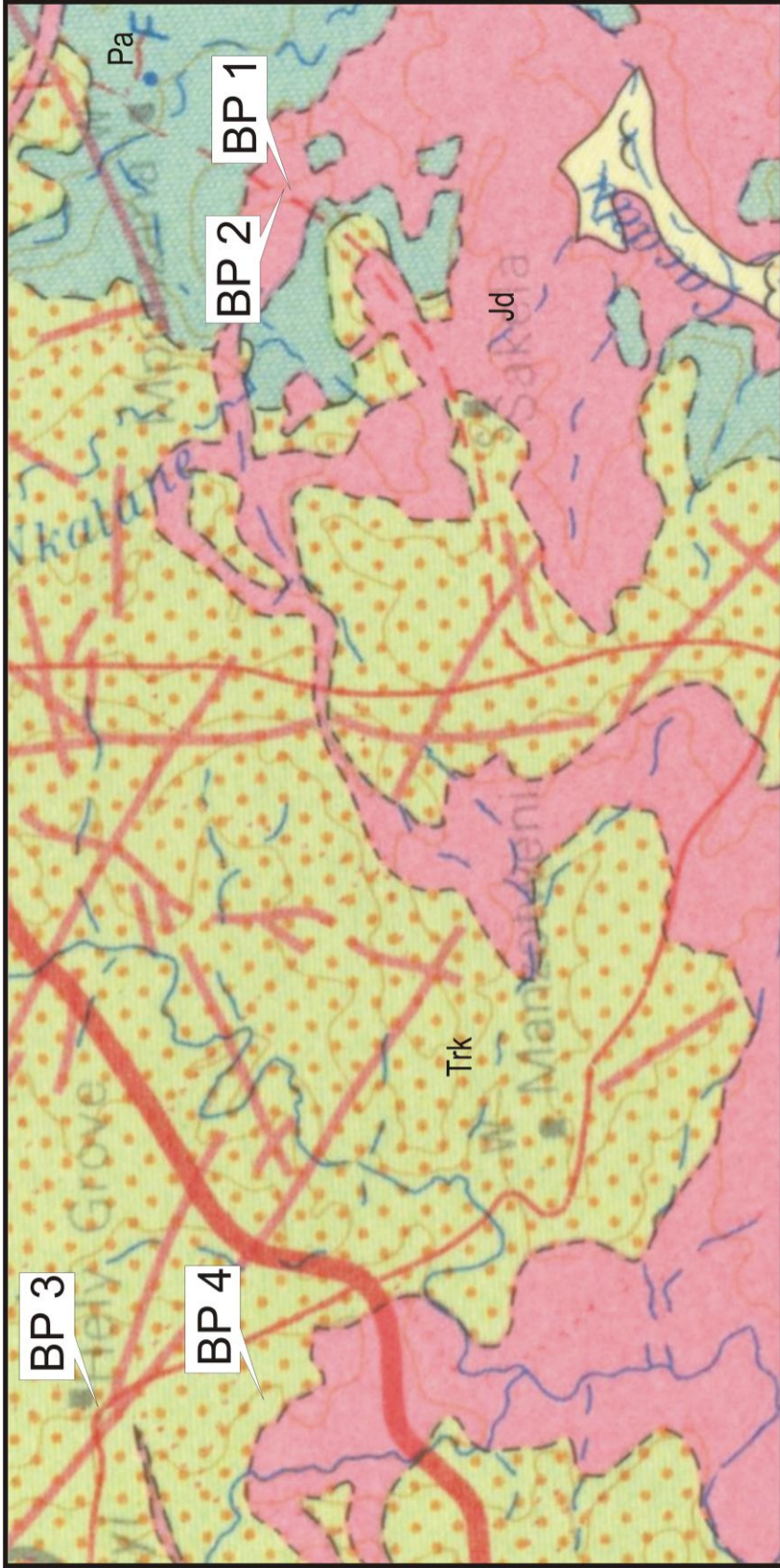


Figure 5. Portion of 1 : 250 000 scale geological map 3128 Umtata. The sites are situated within the Beaufort Group (Karoo Supergroup). From oldest to youngest, Permo-Triassic Adelaide Subgroup (*Pa*) and Katberg Formation (*Trk*, Tarkastad Subgroup), Jurassic dolerite intrusions (*Jd*) and Quaternary alluvium and residual soils (flying bird symbol).



Figure 6. Geographical distribution of vertebrate biozones of the Beaufort Group around Umtata (Rubidge 1995).

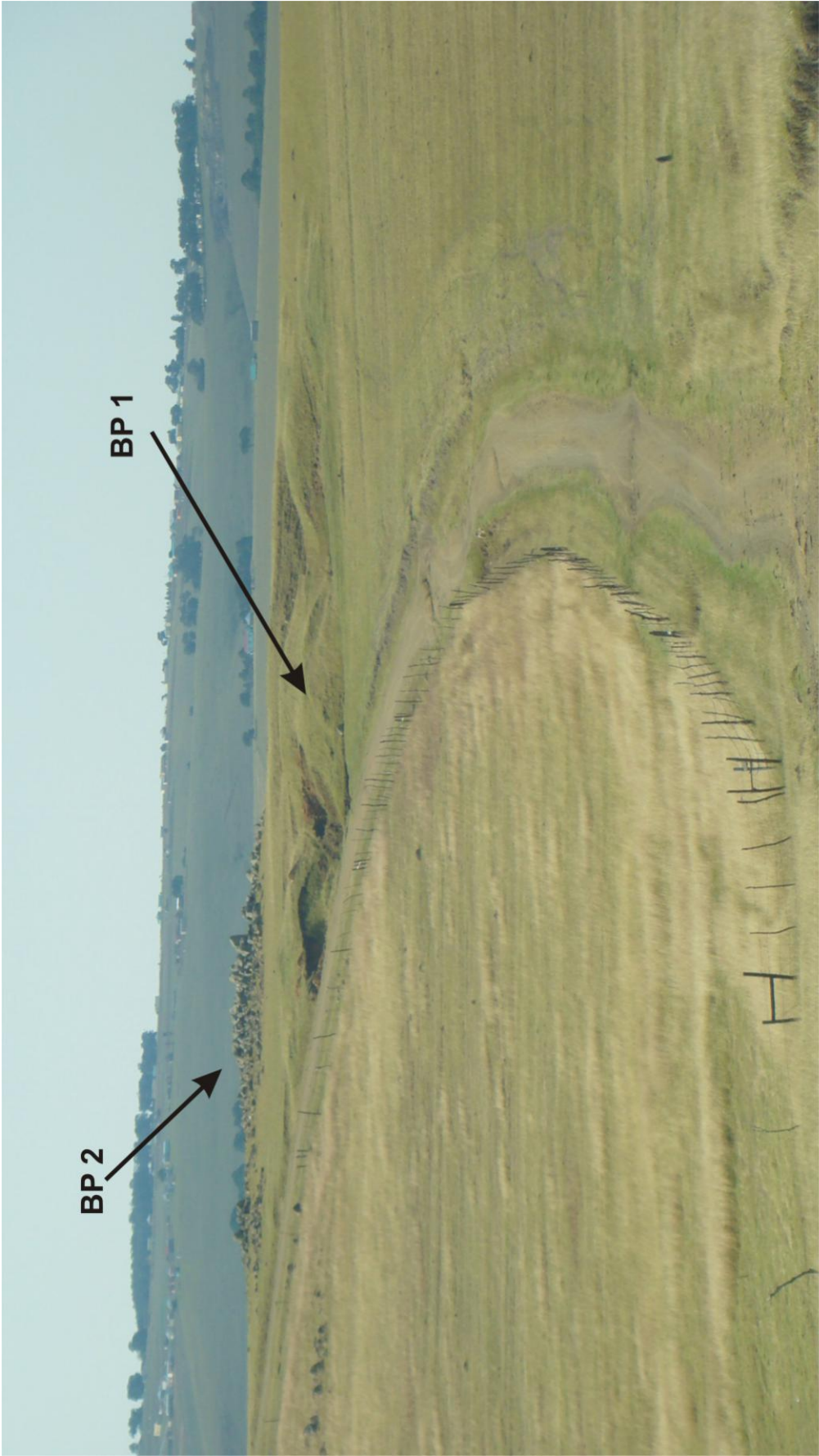


Figure 7. Borrow Pits 1 and 2, looking northeast.

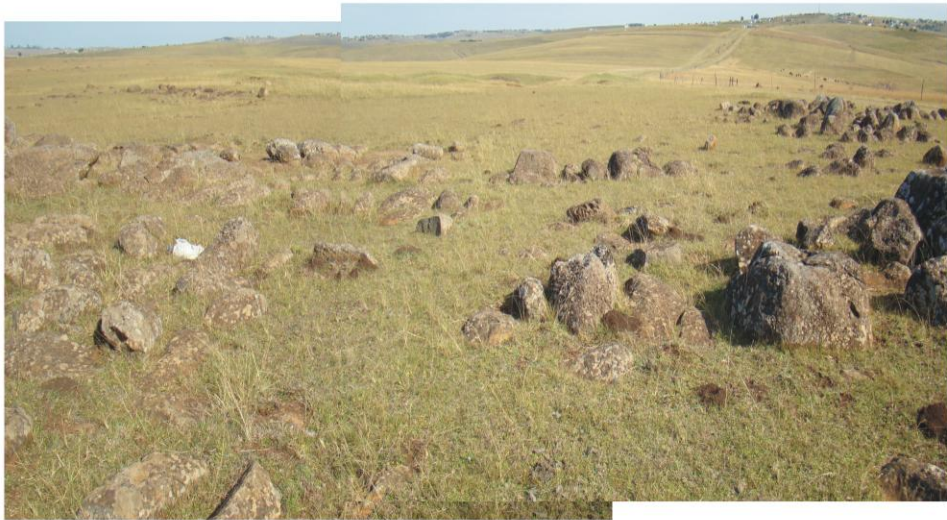


Figure 8. Dolerite outcrop at Borrow Pit 1, looking east (top), south (middle) and southwest (bottom).

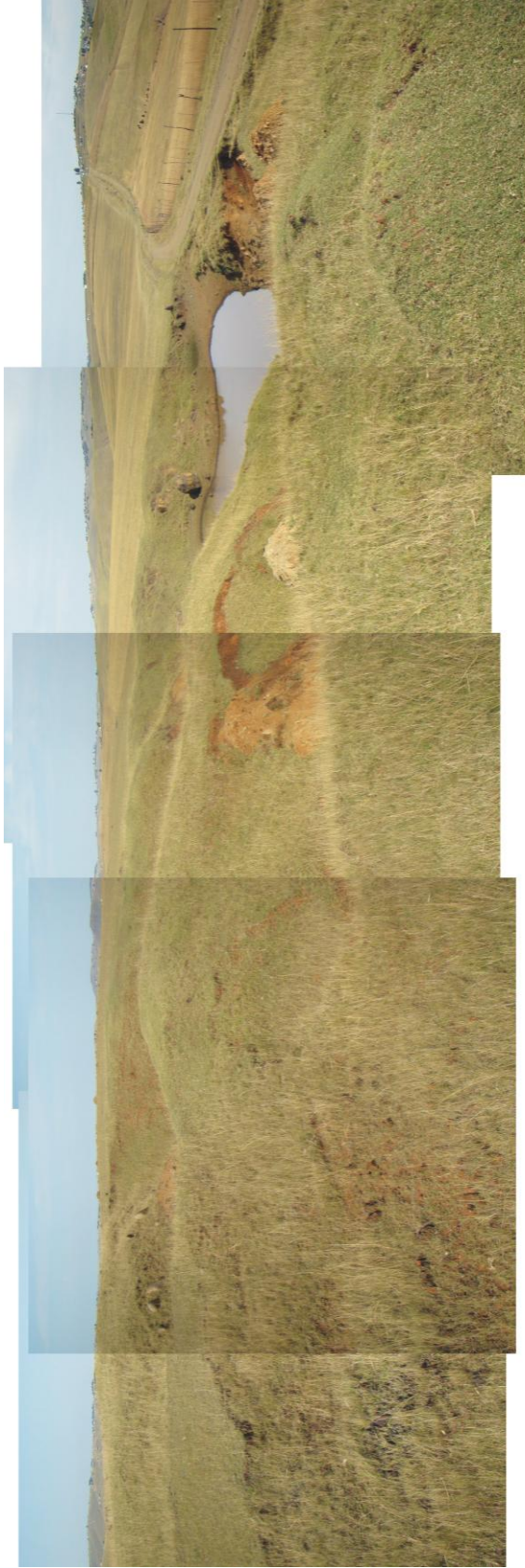


Figure 9. Borrow Pit 2, looking southwest.



Figure 10. Dolerite outcrop at Borrow Pit 2, looking west.

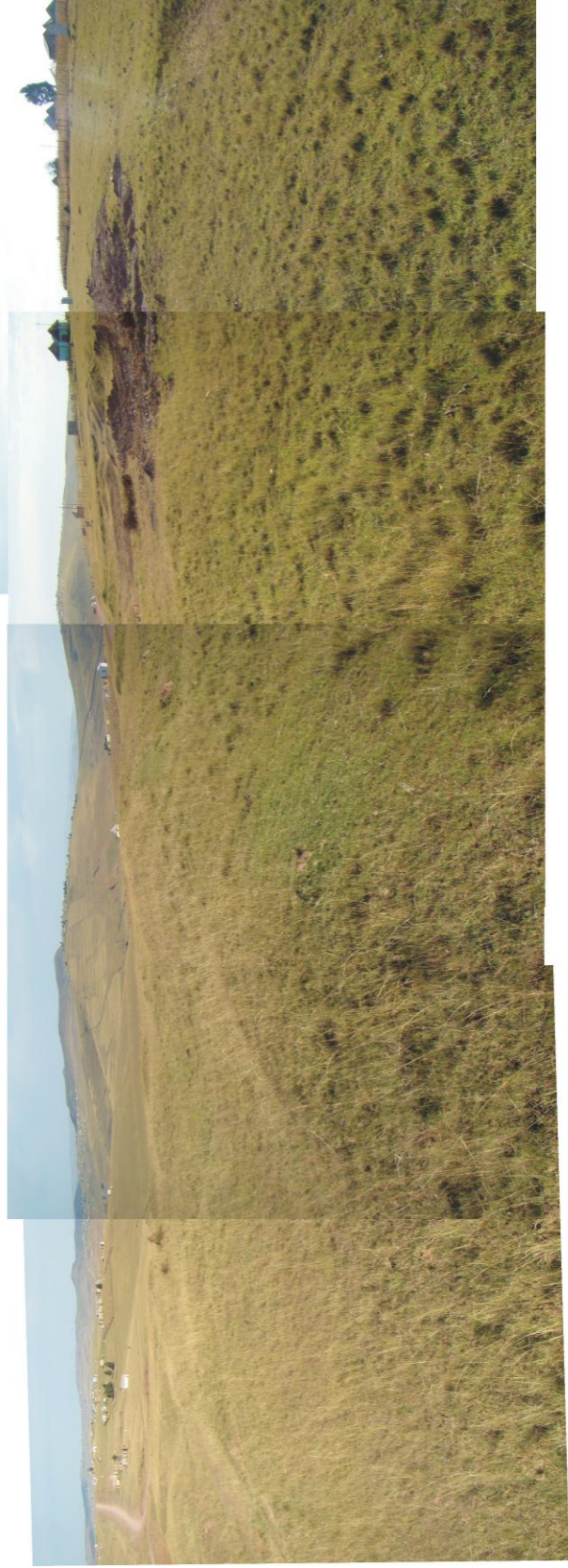


Figure 11. Borrow Pit 3, looking west.

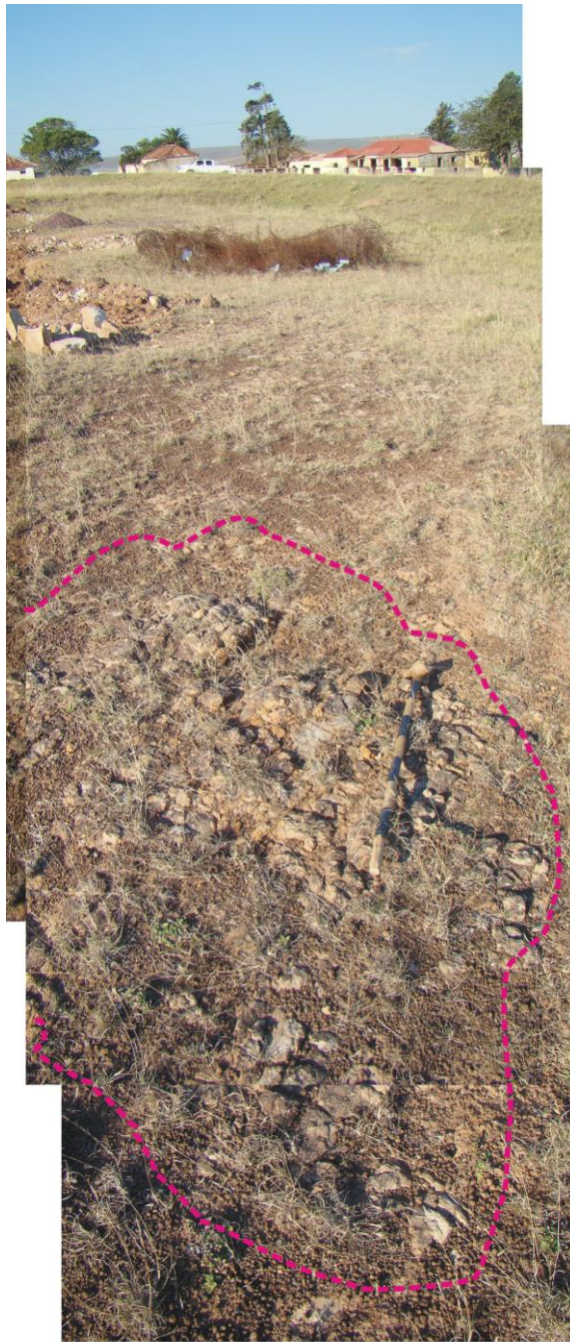


Figure 12. Dolerite outcrop at Borrow Pit 1, looking east.

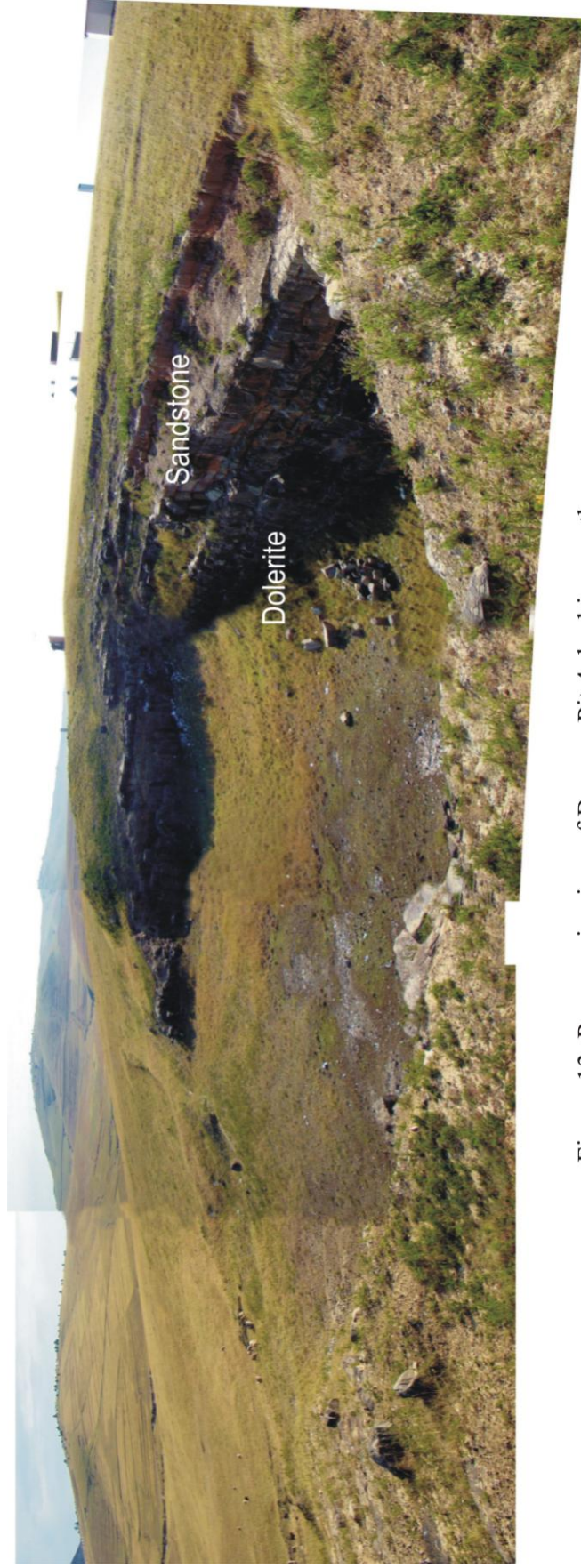


Figure 13. Panoramic view of Borrow Pit 4, looking north.

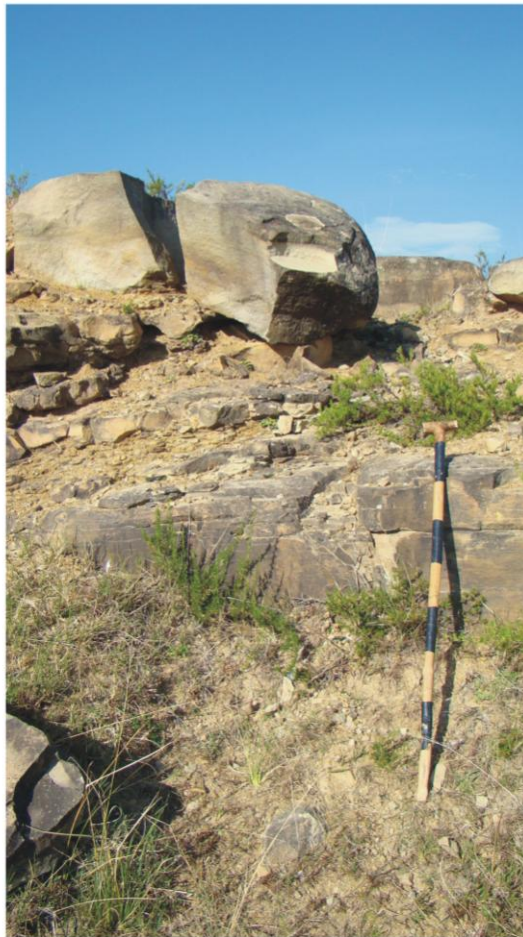


Figure 14. Borrow Pit 4 is an existing quarry cut into dolerite outcrop that is covered by up to 3 m of yellow-grey sandstone and metasediments.