



MESSINA 2002

Map Author - W.H. du Toit
GIS Specialist - A.J.J. du Toit
Cartographer - F. Jonck

Assisted by:
Mapping Management Team
J. Gilman, P. Meyer, J. Jonck and E. Botes
Editorial Board
E. Bruine, J. Gilman, P. Seward and Z.M. Dzembowski (Consultant)

This map was approved by the Director-General of the Department of Water Affairs and Forestry.

Information on roads, rivers, towns and international boundary were obtained from the Civil Directorate: Survey and Mapping, Department of Land Affairs, and edited by the Department of Water Affairs and Forestry. Permission from these respective authorities to make use of their information is gratefully acknowledged. Borehole data were obtained from the National Groundwater Data Base (NGDB) and the Northern Province Regional Groundwater Database. Acknowledgment is also accorded to the Council for Geoscience, A.J.J. du Toit was responsible for the compilation of the borehole distribution map. Precipitation and elevation data were obtained from the Computing Centre for Water Research, University of Natal, and compiled by H. Muller.

Principal groundwater occurrence

Borehole yield class (median l/sec (std. dev. dry boreholes))

	0.0 - 0.1	0.1 - 0.5	0.5 - 2.0	2.0 - 5.0	> 5.0
Interglacial	a1	a2	a3	a4	a5
Fractured	b1	b2	b3	b4	b5
Karst	c1	c2	c3	c4	c5
Interglacial and fractured	d1	d2	d3	d4	d5

Borehole yields boundary (main map only)

Note: Groundwater occurrence depicts the aquifer type(s) with the highest borehole yield, and does not always correlate with surface lithology.

Surface / Sub-surface lithology

(Unconsolidated sediments which are unsaturated, have been omitted from the map)

- Alluvium (sand, silt, gravel and boulders)
- Predominantly argillaceous rocks (shale, mudstone, siltstone and carbonaceous shale)
- Predominantly arenaceous rocks (sandstone and quartzitic sandstone)
- Agillaceous and arenaceous rocks (approximately equal proportions of shale and sandstone)
- Acid extrusive rocks (rhyolite)
- Predominantly meta-arenaceous rocks (gneiss and quartzite)
- Predominantly meta-calcareous rocks (marble and calc-silicates)
- Basic intrusive rocks (diabase and dolerite)
- Basic (ultra) basic metamorphosed intrusive rocks (meta-androsite and meta-pyroxenite)
- Intermediate / alkaline intrusive rocks (syenite)
- Basic extrusive rocks (basalt)
- Predominantly meta-arenaceous rocks (gneiss and quartzite)
- Predominantly meta-calcareous rocks (marble and calc-silicates)
- Predominantly gneissic rocks (with xenoliths of unmetamorphosed rocks)
- Sedimentary rocks: Pe-Tr Metamorphic rocks: Zs
- Various lithologies
- Lithological / stratigraphical boundary
- Interglacial lithological / stratigraphical boundary
- Fault
- Inferred fault
- Dolerite and / or diabase intruded

Large scale groundwater abstraction

- >10 million m³/a
- 2 - 5 million m³/a
- 1 - 2 million m³/a
- 0.1 - 1 million m³/a

Irrigation
Domestic
Mining

Spring flow in l/s shown (pink lines only)
Non-perennial spring
Thermal spring temperature in °C
Artesian borehole (flow in l/s)
Primary drainage region boundary
Water course
Parental river
Secondary perennial river
Non-perennial river
Dam

City / town area
Village
Reference point
Main road
Inset map: National road
Other road (shown for orientation purposes)
International boundary
Not applicable to this map

Chronostratigraphy

1	2	3	4	5	6
Quaternary	O Alluvium (Q)				
Tertiary	T				
1.8 Ma					
65					
142	Cretaceous	K	Makwena F. (Km)		
205	Jurassic	J	Letwaba G. (L); Dolerite (d)		
248	Triassic	Tr	Clarens F. (Cl); Bechoeng F. (B); Sakhu F. (S); Unthintweni G. (U); and Clarens F. (Cl-F)		
280	Permian	P	Ensa G. (Pe)		
294	Carboniferous	C			
354	Devonian	D			
417	Silurian	S			
443	Ordovician	O			
495	Cambrian	E			
545					
	Nambian	N	Dibabane (N-Z)		
900	Phanerozoic				
1800	Mikorian	M	Main map: Swakopburg G. (M); Inset map: Swakopburg G. (M); Funtuna F. (M); Swakop F. (M); Swakop F. (M)		
2000	Vaalian	V			
2650	Randian	R	Basal gneiss (Rg); Hou River gneiss (Rr)		
3100	Seatan	Z	Basal River gneiss (Zg); Aalben gneiss (Za); Mearns G. (Zm); Mearns G. (Zm); Goudaberg gneiss (Zg); Goudaberg G. (Zg); Mearns G. (Zm); Mearns G. (Zm)		

