DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT BK NO. 91/42

GROUNDWATER OCCURRENCE ON THE MANN 1:250 000 SHEET

GEOLOGICAL SURVEY

by

R E READ

and

P S TEWKSBURY

MARCH 1991

DME 437/77

G01566

CONTENTS PAGE

TABLES

FIGURES

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT BK NO. 91/42
DME NO. 437/77
G01566

GROUNDWATER OCCURRENCE ON THE MANN 1:250 000 SHEET

ABSTRACT

The MANN 1:250 000 sheet lies in the extreme northwest corner of SA. The area is arid. The entire sheet is underlain by crystalline rocks of the Musgrave Complex.

Most wells have been drilled near the Mann and Tomkinson Ranges which lie across the northern part of the sheet. This area has both the best well-yields and lowest salinities.

The plains with scattered inselbergs away from the ranges have a low success rate for drilling and salinities up to 5000 mg/L.

Since 1980 the average number of metres drilled per successful well has declined from 95 to 73 in the northern half of the sheet. This is believed to be a combination of deeper drilling and improved well-siting.

Straight valleys and major faults are the best guides to siting successful wells.

About two-thirds of wells drilled through over 20m of saprolite yielded over 0.5 L/s.

Thick saprolite did not improve the chances of finding water in the underlying unweathered rock.

No significant differences were found between rock types in the northern part of the sheet.

In the southern half of the sheet wells drilled in the Wataru Gneiss had a particularly low success rate.

This unit is seldom fractured and even when deeply weathered has low permeability.

One well is known to be in a palaeo-channel. These palaeo-channels are hard to locate, but have the potential for sustained yields.

INTRODUCTION

The MANN 1:250 000 sheet lies in the extreme northwest corner of SA in the Pitjantjatjara Homelands (Fig. 1). Over the last twenty years a considerable amount of drilling has been done firstly in connection with mineral exploration and then for the use of the Aboriginal population who have moved back into the area.

The purpose of this report is to document knowledge that has been gained on groundwater occurrence and well siting.

TOPOGRAPHY AND CLIMATE

The area is arid. Rainfall statistics for Giles 126 km north-west of the north-west corner of the sheet are in Table 1.

Table 1

Rainfall at Giles Meterological Station (1956 to 1988)

Month	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Mean (mm)	30	48	28	16	16	17	10	12	11	16	22	31	256
Median (mm)	19	16	16	2	8	6	2	1	2	5	11	26	245

Although the climate is generally dry heavy rain-fall occurs at times, usually in summer. These infrequent events are probably responsible for most groundwater recharge.

The Mann and Tomkinson Ranges run east-west across the northern part of the sheet, forming both a groundwater and surface water divide.

To the south of the ranges is a large plain with scattered insebergs.

Well defined water-courses are restricted to the ranges of hills and the plains close to them.

GEOLOGY

The sheet has been mapped by Thomson (1962).

The entire sheet is underlain by crystalline rocks of the Musgrave Complex.

The most important structural feature is the Mann Fault. Numerous smaller faults occur in the outcropping rocks of the northern part of the sheet (Fig. 2).

HISTORY

In the 1960's SADME undertook mineral exploration work in the area. At this time most of the Aboriginals had moved to settlements further east.

In the 1970's came the outstation movement, when Aboriginals in small groups moved back into their traditional lands. These groups required reliable water supplies.

In 1975 Pipalyatjara was set up using water wells drilled to supply Mount Davies Camp during the mineral exploration program. Pipalyatjara was originally intended as a staging post for resettlement of traditional homelands, but has now become an established community. Kalka was established in 1978 as a resource centre.

The SADME conducted drilling programmes in the area in 1970, 1976 and 1978.

Since 1980 drilling has been done by an Alice Springs contractor supervised on site by a Pitjantjatjara Council representative. Sites have mostly been selected by a SADME geologist.

DRILLING RECORDS

Prior to 1980 nearly all wells on the MANN sheet were drilled by SADME rigs. These wells are reasonably documented, although few have good geological logs. Samples were often logged off-site by sub-professionals, and in many cases the driller's log is more useful.

About 60 mineral exploration wells have been drilled in the northwest part of the sheet. These are included in the water well records system, but contain no water information and have been disregarded for this study.

Since 1980 drilling has been by private contractors. Well Completion Reports, as required by the Water Resources Act are available for these wells, but the standard of recording varies from good to poor depending on the operator.

Overall the MANN sheet is one of the better recorded portions of, the State with regard to water well drilling.

WELL DRILLING

Table 2 shows all known wells in the area. Locations are in Figure 3.

Table 3 shows a breakdown of numbers of wells in the six 100 000 sheets.

It can be seen that in the three northern sheets (4745, 4845 and 4945). 47 wells have been drilled, 14 yielding over 0.5 L/s. In the three southern sheets only 14 wells have been drilled, and 2 yield over 0.5 L/s.

The large amount of failed drilling around Kumamata has contributed to the low overall success rate in the southern part of the sheet.

However, it is clearly more difficult to locate water supplies in the southern part of the sheet, away from the Mann and Tomkinson Ranges.

TABLE 2 Wells on the MANN sheet

Name	Bedrock* Unit	Unit No	Date Completed	Depth (m)	Depth Water Cut (m)	SWL (m)	Supply L/s	Salinity mg/L	Depth (m)	Strata Descriptions
		4744WW1	12/5/76	40	26	12.5	0.35	1387(D)	0-9 -26 -23 -32 -39.5 -40	Silcrete Clay Silcrete? Sand and siltstone Sand Clay
		2		7	(2nd attempt for /3)					
Kuntjanyu		3	21/11/77	47	44.5 47	10.6	0.6 1.5	1590	-8 -44.5 -47	Mangatija Limestone Clay ?laterite
Aralya	Ꝑmw	4	27/1/82	60			Dry		0-3 -60	Sandy clay Granite
"	Ꝑmw	5	27/1/82	60			Dry		0-6 -60	Sandy clay Granite
"	Ꝑmw	6	10/8/87	12			Dry		-2 -11.5 -12	Sand Sandstone Granite
"	Ꝑmw	7	9/3/87	22	13.22	13.60	0.6	6565	 -12 -22.5	-1Soil Gravelly clay Soft limestone
"	Ꝑmw	8	11/8/87	2.5			Dry		0-2 2.5	Clay granite

* Taken from geological map

G01566

Name	Bedrock* Unit	Unit No	Date Completed	Depth (m)	Depth Water Cut (m)	SWL (m)	Supply L/s	Salinity mg/L	Depth (m)	Strata Descriptions
	Ꞓmm b?	4745WW1	15/12/56	12.8	-	-	-	-	0-1.2	Red silts + fine sands
									1.2 -7.6	Subangular pebbles + silicified
									7.6-12.8	grey crystalline rock
	Ꞓmm b	4745 2	30/1/57	45.7	33.5	18.0	0.39	1404	0-4.5	Red silts + sand
									4.5-23.2	Brown sandy limestone
									23.2-44	Weathered clay
									44-46	Metasediment
	Ꞓβg?	4745 3	16/8/55	33.5	28.0	27.1	0.65	687	0-2.4	Rusty brown fine sands
									2.4-7.0	Sandy limestone
									7.0-19.5	Sandy marl
									19.5-31.1	Brown, white, grey sands, gravels, pebbles
	Ꞓmm i?	4745 4	24/8/55	32.9	22.6	20.1	1.04	662	0-2.7	Sand clay fine gravel
									2.7-8.8	Marly sands + gravels
									8.8-13.7	Cream and blue limestone with quartzite + gravel
									13.7-28.0	Sandy limestone + gravel
									28.0-32.9	Weathered granite

G01566

Name	Bedrock* Unit	Unit No	Date Completed	Depth (m)	Depth Water Cut (m)	SWL (m)	Supply L/s	Salinity mg/L	Depth (m)	Strata Descriptions
	Ᵽmm i?	4745 5	27/7/55	37.5	24.4	21.3	0.13	523	0-0.6	Sand clay
									0.6-2.7	Sand marl
									2.7-8.8	Clay with sand + Fe rich gravels
									8.8-15.2	Granitic gravels - jasper chips
									15.2-17.1	Grey conglomeratic limestone
									17.1-31.1	Various sands, gravels and pebbles
	Ᵽmm a	4745WW6	23/10/56	26.5	-	-	-	-	0-2.6	Clay
									2.6-7.9	Gravel and clay
									7.9-12.2	Weathered
									12.2-26.5	Amphibolite
	Ᵽmm a	4745 7	31/8/55	12.8	-	-	-	-	0-5.8	Sandy clay
									5.8-7.6	Sandy marl + quartzite
									7.6-12.8	Grey + blue quartzite
	Ᵽmm a	4745 8	1/11/56	7.6	-	-	-	-	0-3.0	Weathered granite
									3.0-7.6	Silicified rock.
	Ᵽmm i	4745 9	9/9/55	13.7	-	-	-	-	0-1.1	Red sandy clay
									1.1-3.9	Brown gritty marl
									3.9-9.1	Gritty marl + gravel
									9.1-13.7	Coloured quartzite

Name	Bedrock* Unit	Unit No	Date Completed	Depth (m)	Depth Water Cut (m)	SWL (m)	Supply L/s	Salinity mg/L	Depth (m)	Strata Descriptions
	Ɛmm i	4745 10	15/7/55	39.6	32.9	32.9	0.05	-	0-0.5	Red soil
									0.5-1	Sheet limestone
									1-3.0	Limestone marl
									3.0-24.4	Limey clay
									24.4-37.5	Weathered granite
									37.5-39.6	Granite gneiss
	Ɛbg ?	4745 11	14/9/55	45.7	40.8	33.5	0.07	1165	0-1.5	Brown sandy soil
									1.5-3.7	Light brown marl + fine gravel
									3.7-7.6	Clay + granite + quartzite gravel
									7.6-15.2	Brown + grey clay + fine gravel
									15.2-37.8	Brown/grey marl with granite grit + mica
									37.4-45.7	Light green + blue quartzite + schist
	Ɛbg ?	4745 12	6/9/55	36.9	-	-	-	-	0-1.5	Brown fine sandy soil
									1.5-3.4	Brown rubbly travertine limestone
									3.4-5.8	Fine sand, gravel + limestone
									5.8-15.2	Pati clay + granitic ferruginous quartz gravel.
									15.2-21.3	Marl + some white clay
									21.3-36.9	Grey/bluish quartzite

Name	Bedrock* Unit	Unit No	Date Completed	Depth (m)	Depth Water Cut (m)	SWL (m)	Supply L/s	Salinity mg/L	Depth (m)	Strata Descriptions
		4745 13	Mineral Investigation							
		4745 14	14/10/65	74.98	48.8	-	-	851		Mineral Investigation
		4745 15	Mineral Investigation							
		4745 16	19/10/65	44.5	38.1	-	-	649		Mineral Investigation
		4745 17								Mineral Investigation
		4745 18								Mineral Investigation
		4745 19								Mineral Investigation
		4745 20	1/11/65	62.2	47.2	42.1	-	790		Mineral Investigation
		4745 21								Mineral Investigation
		4745 22								Mineral Investigation
		4745 23								Mineral Investigation
		4745 24								Mineral Investigation
		4745 25								Mineral Investigation
		4745 26								Mineral Investigation
		4745 27								Mineral Investigation
		4745 28								Mineral Investigation
		4745 29								Mineral Investigation
		4745 30								Mineral Investigation
		4745 31								Mineral Investigation
	Emm a	4745 32	9/10/70	30.5	18.6	17.1	0.13	800	0-1.5 1.5-6.1 6.1-30.5	Silt Limestone Quartzite (gneiss grey)
Nyumbantja (MD3)	Emm a	4745 33	3/10/70	31.4	25.0	22.3	0.47	645	0-1.5 1.5-3.1 3.1-31.4	Silt Conglomerate Quartzite (sandstone)

Name	Bedrock* Unit	Unit No	Date Completed	Depth (m)	Depth Water Cut (m)	SWL (m)	Supply L/s	Salinity mg/L	Depth (m)	Strata Descriptions
	Ꝑβg	4745 34	30/9/70	18.3	16.5	14.3	0.33	1015	0-3.1	Siltstone
									3.1-6.2	Conglomerate
									6.2-12.4	Limestone
									12.4-18.3	Quartzite
	Ꝑmm a?	4745 35	26/9/70	35.1	24.4	21.5	3.9	614	0-1.5	Calcareous silt
									1.5-3.1	Conglomerate (grains + quartz)
									3.1-23.4	Siltstone + limestone fragments
									23.4-33.5	Conglomerate (gneiss + quartz)
									33.5-35.1	Siltstone + gneiss
	Ꝑmm a?	4745 36	6/10/70	34.1	24.4	2.1	3.7	670	0-1.5	Siltstone + fine quartz
									1.5-12.2	Conglomerate Siltstone + gneiss
									12.2-28.9	Siltstone + limestone
									28.9-34.1	Gneiss + sandstone
	Ꝑmm a	4745 37	13/10/70	32.0	29.3	18.0	0.8	700	0-1.5	Silty clay
									1.5-13.7	Limestone, sandstone
									13.7-32.0	Quartzite + some Gneiss
	?	4745 38	15/10/70	39.6	20.4	17.4	0.65	637	0-1.5	Sandy clay
									1.5-12.2	Limestone + some fine quartz

Name	Bedrock* Unit	Unit No	Date Completed	Depth (m)	Depth Water Cut (m)	SWL (m)	Supply L/s	Salinity mg/L	Depth (m)	Strata Descriptions
									12.2-19.8	Conglomerate (quartz + siltstone)
									19.8-39.6	Silty + sandy conglomerate quartzite + limestone fragments.
		4745 39-71								Mineral Investigation
	Ꝑβg b	4745 72	14/5/76	6	-	-	-	-	0-6	Alluvial sand and gravels (some weathered granitic matrix).
	Ꝑβg b	4745 73	15/5/76	50	-	-	-	-	0-5	Alluvial sandy gravels.
									5-50	Partially weathered to fresh granite.
	?	4745 74	15/11/77	4	-	-	-	-		
	?	4745 75	15/11/77	57	32	-	-	-	0-0.5	Sand
					37	-	-	4850	0.5-5.5	Calcrete
					42	-	0.3	5200	5.5-14	Siltstone + calcrete concretion
									14-15	Calcrete
									15-57	Clay silty with calcrete concretions.
	Ꝑmm i	4745 76	7/12/77	14	-	-	-	-	0-14	Sand, gravel

Name	Bedrock* Unit	Unit No	Date Completed	Depth (m)	Depth Water Cut (m)	SWL (m)	Supply L/s	Salinity mg/L	Depth (m)	Strata Descriptions
	Ᵽmm i	4745 77	8/12/77	22.5	14.5	11.5	0.32	600	0-3 3-9 9-27.5	Silty gravely clay Alluvial gravel Siliceous duricrust.
	Ᵽβg ?	4745 78	23/9/78	40.5	34	30	1	540	0-3 3-24 24-40.5	Red soil Calcrete sand Fine sand + rubbly jasper + gabbro gravel.
	Ᵽmm a	4745 79	27/9/78	16.5	11.5 13.0	- 9.3	- 1.8	- 800	0-3 3-16.5	Red sand clay Granulite (highly weathered at top)
	Ᵽmm a	4745 80	29/9/78	50.5	30.8	30.5	-	-	0-2 2-12 12-50.5	Alluvium Strongly weathered granulite Slightly weathered granulite
		4745 81 82								Mineral Investigation Mineral Investigation
	Ᵽmm a	83	2/7/82	43	36	23	1.0	610	0-6 6-21 21-37 37-43	Top soil Broken limestone Sandy clay Fresh granite
Kalka In valley near major fault zone	Ᵽmm	4745 84	25/1/82	49	Dry	-	-	-	0-24 24-36 36-44	Clay Broken granite Granite quartz

Name	Bedrock* Unit	Unit No	Date Completed	Depth (m)	Depth Water Cut (m)	SWL (m)	Supply L/s	Salinity mg/L	Depth (m)	Strata Descriptions
Kalka In valley near major fault zone.	Ᵽmm	85	26/1/82	40	27	-	0.9	-	0-12 12-24 24-30 30-40	Clay Gravelly clay Gravel + sand. Clay.
Ilitjara In straight valley at 020°T parallel to small faults	Ᵽmma	86	1/7/82	30	18 26	- 14.5	seepage 0.6	- 590	0-3 3-6 6-24 24-27 27-30	Topsoil Broken granite Sandy clay Sandy clay + broken granite Granite
Pipalyatjara MD 11 In open area away from hills.	?	87	7/5/83	36	-	Dry	-	-	0-2 2-24 24-36	Clay Broken granite + clay. Hard granite.
Yaparng In centre of straight E-W valley	?	88	2/4/84	60	Dry	-	-	-	0-3 3-36 36-61	Sand Sand + clay Sandy clay with bits of decomposed granite.
Nyikakurra Open sand-hill area, no siting	?	89	1/4/84	42	18 34	- 25	seepage 4.0	- 1080	0-24 24-42	Sandy + clay Broken granite.
Yaparng Along strike from mafic/ultramafic rocks over possible fault.	Ᵽβg	90	27/4/87	30	Dry	-	-	-	0-6 6-18 18-30	Sand clay Clay Granite

Name	Bedrock* Unit	Unit No	Date Completed	Depth (m)	Depth Water Cut (m)	SWL (m)	Supply L/s	Salinity mg/L	Depth (m)	Strata Descriptions
Yaparng ? drillers site	?	91	28/4/87	30	Dry	-	-	-	0-6 6-18 18-30	Sandy clay Weathered granite Quartz
Pipalyatjara MD 13 Over gabbro close to two major fault zones.	Ɛβg	4745 92	16/5/88	43	23	17	2	770	0-3 3-9 9-38 38-43	Brown soil Calcrete Gabbro weathered Fresh gabbro
Yaparng Drillers site	Ɛmma	93	23/9/88	50	33.5 44	33.5	0.75	615	0-4 4-33 33-50	Sand Sandy clay Gravels

		Local Name	Unit Number	Date Drilled	Depth (m)	Water Cut	Water Level	Supply l/s	Salinity	Log	
	Pmma		4845 1	8/10/66	36.6	24.4	21.8	0.33	645		
	$P\gamma_5$	Lake	4845 2	1/4/76	54.5	39					
		Wilson 1				43	3.25	0.9	1675	0-2	Alluvial Sand
										2-16	Alluvial sand + gravels
										16-24	Sandy gravelly clay
										24-32	Clay (Plastic)
										32-42	Silcrete
										42-54.5	Fractured pebbly weathered feldspar gneiss.
	Pmma	YY1	4845 3	18/5/76	20.5	11.5	8.3	0.9	790	0-2	Alluvial sand
										2-3	Weathered granulite
										3-14	Partly weathered granite
										14-19	Black basic dyke
										19-20.5	Dense granulite
	Pmma		4845 4	29/1/82	49	27	-	0.25		0-24	Clay
						40	_	3.7		24-36	Gravelly clay
										36-43	Gravel + Sand
										43-49	Clay
Open area, no siting	?	Willi	4845 5	1/4/84	36	21	13	1.5	2000	0-2	Sand
		Willi								2-4	Granite
										4-36	Hard sand + clay
			4944 1	20/10/70	25	Dry			0-6	Sand	
										6-14	Sandy clay
										-17	Sandstone ......
										-19	Gravel
										-25	Granulite

		Local Name	Unit Number	Date Drilled	Depth (m)	Water Cut	Water Level	Supply l/s	Salinity	Log	
		Ɛmma	2	25/10/70	32		Dry			0-3 -6 -10 -21 -32	Sand Gravel Sand and quartzite Soft within quartzite Fresh quartzite
		Ɛmma	3	24/3/76	38		Dry			-2 -6 -22 -38	Sand ...... gneiss Slightly .... Fresh gneiss
		Ɛmma	4	23/3/76	5		Dry			-2 -5	Sand W.... gneiss
		Ɛγ_5	5	26/3/76	36	18	7.6	0.4	750	-7 -18 -34 -36	Sand Clayey sand w.... and gravel grainstone Fresh granitoid
		Ɛmma	6	26/3/76	8		Dry				
		Ɛmma	7	26/3/76	7.5			Dry		-4 -7	Sand Part within granulite
		Ɛmma	4944 8	27/3/76	31.5	85	8.1	0.5	540	-1.5 -3 31	Sand Dolerite Granulite
Kunamata	In gap suspected fault	?	9	5/7/82	43	33		0.35	830	-6 -21 -43	Sand Sand and clay Granite

			Local Name	Unit Number	Date Drilled	Depth (m)	Water Cut	Water Level	Supply l/s	Salinity		Log
Kunamata	Redrill of 4944/5	Ᵽγ_5		10	30/1/82	43		Nil				7m from /5
Kunamata	Redrill of 4944/5	Ᵽγ_5		11	30/1/82	18		Nil				1m from / 5
		Ᵽmma		4945 1	17/6/66	55	35	24	0.5	830	-3 -18 -55	Sand Clay Acid granulite, part weathered
		Ᵽmma		2	6/5/66	15			Dry		-3	Sand and gravel granulitic become fresh and depth.
		Ᵽmma		3	5/5/66	46			Small	700	-4 -32 -46	Sand Clay Granulitic
		Ᵽmma		4	18/10/70	38		27	0.01	790	-6 -11 -24 -27 -38	Sand Sandy clay Granulite, some soft bands Sandstone Granulite
		Ᵽmma		5	23/10/70	31			Dry		-4 -12 -14 -20 23 31	Sand Sandy clay Limestone Granulite Sandstone Dense granulite
		Ᵽmma		6	28/8/78	35	9 22 29	7	 0.45	 1360	-6 -21 -34	Sand Weathered Ᵽmm Weathered Ᵽmm

			Local Name	Unit Number	Date Drilled	Depth (m)	Water Cut	Water Level	Supply l/s	Salinity		Log
		$P\gamma_8$		7	3/10/78	30	14 23	10	0.47	660	-6 -9 -12 -30	Clayey sand Clayey sand + bedrock Weathered granulite Granulite
				8		8						Abandoned (twist off)
Walpa	SE end of Mann Ranges	Pmma		9	3/7/82	52	47	23	0.6	770	-6 -20 -48 -52	Sand Clay Sand Broken granite
Angatja	Attempt to intersect fault at 090°T	$P\gamma_5$		10	11/10/82	52			seepage		-6 -9 -54	Sandy clay Weathered granite Granite
Angatja	In valley N of Angatja	$P\gamma_5$		11	11/10/88	36			Nil		-8 36	Sandy clay Granite
Umpukula	In valley SE of Mann Range, standby for 4945/5	?		12	4/5/88	55			1	500		Alluvium.
Angatja	In gap on trace of well-jointed zone at 170°T	$P\gamma_5$		13	15/5/88	43			Dry		-6 -43	Sand Pmm
Kanypi	Stand by for 4945/6 opposite N-S trending valley and about 1km N of Mann Fault.	Pmma		14	16/5/88	43	37		0.5		-3 -6 -13	Sand Calcrete Very weathered granulite

TABLE 3 Wells in 1:100 000 sheets

Sheet	No. of Recorded Wells	No. of* Water Wells	No Yielding over 0.5 L/s		Median Yield L/s
4744	8	6	2	(one saline)	0
4745	93	29	14		0.3
4844	0	0	0		-
4845	5	5	4		0.9
4944	11	8	0	(Most in Kunamata area)	0
4945	14	13	6		0.01
TOTAL	131	61	24		

* Leaving out mineral investigation wells and wells abandoned at shallow depth because of drilling problems.

Drilling results from before and after 1980 were compared for the northern three sheets (Table 4).

TABLE 4 (Sheets 4745, 4845, 4945)
Comparison of drilling before and after 1980

	Pre 1980	Post 1980
No. Water wells	38	18
Total metres	1 232	727
Average depth	32	40
Median yield (L/s)	0.4	0.6
Wells > 0.5 L/s	13 (34%)	10 (56%)
Well > 1 L/s	7 (18%)	5 (28%)
metres drilled per well with >0.5 L/s	95 m	73 m

Deeper drilling, and possibly better siting has resulted in improved success.

Well Completion

Most wells yield water from fairly competent rock and can be completed either open-hole or with slotted casing.

One well in sand in a palaeochannel required a screen for successful completion.

WELL SITING

Since 1982 the geologist's reasons for siting wells have been recorded. The most commonly used guides are linear features, that is straight valleys and water courses that apparently mark better fractured zones.

HYDROGEOLOGY

The entire sheet area is underlain by crystalline rocks at shallow depth with a thin cover of Cainozoic sediments.

Cainozoic Sediments

Only one well (4945/12) is definitely known to be in an alluvial aquifer. The nearby well 4945/9 appears from the drillers log to be in slightly weathered basement. Weathered crystalline rocks resemble sands and gravels and are recorded as such by drillers, hence it is possible that a few other wells are in alluvial aquifers.

Alluvial deposits associated with present day streams are too thin to contain reliable aquifers. Deeply incised palaeo-channels, with little or no surface expression, such as those intersected by 4945/12, have the potential to yield large supplies. Because they are relatively narrow, geophysics would be needed to locate these economically.

Calcrete aquifers are widespread in the adjacent region in Western Australia (Wharton, 1984). No calcrete aquifers are known on the MANN Sheet. At Kuntjanyu outcropping Mangatija Limestone may allow water to infiltrate to underlying aquifers.

Crystalline Rocks

Fractured crystalline rocks and saprolite formed by the weathering of crystalline rocks are the most widespread aquifers on the sheet. Saprolite aquifers form where groundwater can circulate through fissures and react with the rock.

In many cases the strongly weathered zone has low permeability, but the slightly weathered and fractured zone beneath it is an aquifer. This is most likely to occur in areas of structural disturbance where jointing is well-developed.

The Mann Fault is an example of such a zone. While the initial faulting probably took place at depths too great for fractures to develop subsequent erosion and release of stress within the mylonites in the fault zone has caused intense fissuring. A zone along the trace of the fault is weathered to a depth of 40 to 60 m. This weathered zone is usually, but not always, permeable.

Both yields and salinity are best in the northern part of the area around the Mann and Tomkinson Ranges.

The better yields are probably a result of better fracturing in this area.

The lower salinities are probably due to a combination of the following factors:

1. Better permeability, as noted above
2. Greater topographic relief generating higher hydraulic gradients and more efficient flushing.
3. Run off from the ranges is available for recharge.

Fewer wells have been drilled south of the ranges, but the success rate is much lower.

This is partly because the cover of wind blown sand has obscured lineaments and partly because the area is less deformed and fewer aquifers have developed.

The influence of rock type was studied by using the geological map to infer the geological unit penetrated.

Results are shown in Table 5.

TABLE 5 Comparison of well-yields with rock types

Rock type	No of Wells	Wells > 0.5 L/s	Wells > 1 L/s
Acid granulite Ꝑmm	27	12 (44%)	6 (22%)
Intermediate granulite Ꝑmm	6	1 (17%)	1 (17%)
Basic granulite Ꝑmm	3	1	0
Giles Complex Gabbro	7	3	1

Ᵽβg		(43%)	(14%)
Kulgeran Granite Ᵽγ_5	5	0	0
Wartaru Gneiss Ᵽmw	5	1	0
TOTAL	54	18 (33%)	9 (17%)

The acid granulites are the most widespread rocks in the area and most wells have been drilled in them. Too few wells have been drilled in other rock types to allow reliable comparisons. Wharton (1984) considered that in the adjacent region in WA Giles Complex mafic and ultramafic rocks, where weathered, were better aquifers than granites, gneisses and granulites.

Elsewhere in WA highly weathered ultramafics have yielded large supplies (Whincup & Barnett, 1988).

This contrasts with experience on other continents that basic rocks such as gabbro fracture poorly (UNESCO, 1984 p47) and weather to clayey material of low permeability (UNESCO, 1984 p43).

Giles Complex basic and ultrabasic rocks on the MANN sheet have a slightly better success rate, but the difference would not be statistically significant. It is likely that these rocks have not been drilled in the most favourable areas where deep weathering may occur.

The Kulgeran Granites appear to be worse aquifers than the granulites.

On the evidence in Table 5 the Wataru Gneiss is a poor aquifer on the MANN Sheet. On the EVERARD sheet of 16 wells in the Wartaru Gneiss (40%) yielded more than 0.5 L/s and 4 (27%) more than 1 L/s (Read, 1990). Fifteen wells on the BIRKSGATE sheet, immediately south of the MANN sheet wells all yielded less than 0.5 L/s (Read, 1989).

The above results are attributed to two factors:

a. The Wataru Gneiss occurs in less tectonically disturbed areas and is therefore less fractured.
b. The Wataru Gneiss weathers to material of low permeability.

An attempt was made to study the relationship between the depth of saprolite and well yields.

This was found to be very difficult because of wildly inconsistent reporting between different drillers and geologists.

Many wells have been logged off site. The logs are a description of cuttings without reference to drilling conditions, such as caving and penetration rate, and are difficult to interpret.

Further not all wells pass through the sequence of clay, weathered but recognizable crystalline rock, fresh rock. In some instances silcrete bands have been recorded deep in the weathering profile. In other cases corestones of fresh rock may occur between bands of clay developed along joints.

A plot of well-yield against saprolite depth is shown in Figure 4.

The large number of wells with thin saprolite and low yields is due, in part to many of these wells being abandoned at shallow depth.

14 wells are reported as having over 25m of saprolite. One of these may in fact be in alluvium.

A breakdown of well yields is shown below in Table 6.

TABLE 6 Well yields and saprolite thickness

Depth of Saprolite (m)		0-10	10-20	20-30	30-40	40-50	50-60
No of Wells		15	10	9	6	5	3
Wells tapping fractured rock aquifers							
	≥0.5 L/s	3(20%)	2(20%)	3(33%)	1(13%)	0	0
	≥1 L/s	2(13%)	0	2(22%)	0	0	0
	≥2 L/s	1	0	0	0	0	0
Wells tapping Saprolite aquifers							
	≥0.5 L/s	0	1(10%)	3(33%)	3(50%)	3(60%)	2(67%)
	≥1 L/s	0	0	3(33%)	2(33%)	2(40%)	2(67%)
	≥2 L/s	0	0	2(22%)	0	2(40%)	1(33%)
All aquifers							
	≥0.5 L/s	3(20%)	3(30%)	6(67%)	4(67%)	3(60%)	2(67%)
	≥1 L/s	2(13%)	0	5(55%)	2(33%)	2(40%)	2(67%)
	≥2 L/s	1(6%)	0	2(22%)	0	2(40%)	1(33%)

TABLE 7 ANALYSES

Unit	No.	year	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO3 mg/L	SO4 mg/L	Cl mg/L	F mg/L	NO3 mg/L	Cond. ECU	pH	TDS mg/L
4744	/ 3	1977	116	80	285	47	364	249	480	.	35	.	8.1	1471
4744	/ 3	1978	121	85	285	60	364	254	516	.	90	2653	7.9	1590
4744	/ 7	.	311	395	1300	135	345	1067	2619	0.8	143	9880	7.4	6565
4745	/ 2	1957	99	67	273	.	69	208	480	.	.	.	.	1270
4745	/ 4	1955	26	94	97	.	121	63	144	.	.	.	.	656
4745	/ 5	1955	20	46	77	.	44	73	134	.	.	.	.	428
4745	/32	1970	52	95	121	6	470	130	180	.	20	1460	.	834
4745	/33	1970	48	52	71	5	380	45	95	.	.	1000	.	501
4745	/34	1975	23	132	160	5	441	85	302	0.5	30	.	8.5	974
4745	/34	1980	19	104	145	4	476	68	288	0.3	35	.	8.2	843
4745	/34	1970	16	136	154	6	425	95	340	.	20	1750	.	977
4745	/35	1970	14	98	110	5	480	55	155	.	20	1220	.	.
4745	/35	1970	21	89	90	4	475	45	130	.	.	1200	.	614
4745	/36	1970	19	95	108	6	475	55	165	.	.	1210	.	.
4745	/37	1970	25	82	128	16	515	45	150	.	20	1300	.	721
4745	/38	1988	43	71	106	3	418	52	160	0.7	31	1200	7.6	741
4745	/38	1970	36	78	98	5	445	50	150	.	.	1210	7.5	637
4745	/75	1977	303	190	1322	26	339	1123	2170	.	22	8159	8	5322
4745	/78	1978	47	61	79	4	36	53	90	0.1	40	.	8	540
4745	/78	1978	47	51	79	4	356	53	90	0.7	40	926	8	540
4745	/83	1982	48	65	73	4	360	68	110	0.7	38	980	7.7	610
4745	/86	1982	76	45	64	5	336	52	94	1.1	81	.	.	.
4745	/92	1988	22	106	114	3	446	56	205	0.3	33	1390	7.7	813
4745	/93	1988	39	39	116	9	283	83	120	0.5	15	945	7.7	615
4845	/ 2	.	19	37	511	41	170	251	636	.	25	3000	8.9	1637
4845	/ 3	1976	79	71	62	5	279	41	130	.	190	1316	7.9	715
4944	/ 5	1976	68	45	145	2	344	126	146	1.4	47	1309	7.6	750
4944	/ 8	1976	41	32	117	4	386	29	94	1.7	32	967	7.7	541
4944	/ 9	1982	44	23	232	19	305	98	260	1.3	20	1420	8	830
4945	/ 1	1975	30	29	146	9	381	31	72	3.1	21	963	8.7	561
4945	/ 3	1966	53	51	82	.	304	77	132	.	.	.	7	699
4945	/ 4	1970	60	36	122	20	260	55	210	.	30	1290	.	663
4945	/ 6	1978	71	81	324	16	675	150	352	1.9	30	2307	8.2	1358
4945	/ 7	1978	79	49	95	12	416	45	157	.	4	1172	8	646
4945	/ 9	1982	69	43	150	14	.	64	200	1.4	52	1260	7.7	770

Clearly wells penetrating over 25m of saprolite have better than usual yields on the MANN sheet.

A greater depth of saprolite does not appear to improve the chance of finding useful supplies in the underlying little weathered rock. This agrees with findings on the ALBERGA and EVERARD sheets (Read, 1989a and 1990).

On the ALBERGA sheet wells in thick saprolite were found to be more likely to have moderate yields, but less likely to have yields over 2 L/s.

Figure 5 shows the distribution of standing water levels on the MANN sheet.

These figures are mostly based on information supplied by drillers, and are likely to contain errors since water levels are usually measured immediately after drilling when large residual drawdowns may be present.

WATER QUALITY

There is no significant grazing of stock in the area and water is generally required for human consumption.

As in most of the arid inland parts of Australia salinity and nitrates are common problems. Crystalline rock areas such as the MANN sheet commonly also have excessive fluorides.

Water analyses are shown in Table 6.

Nitrate contents are generally lower than in other parts of the Pitjantjatjara Lands (Read, 1990) (Fig. 6). Only three analyses show more than 45 mg/L nitrate. Significantly two of these are the southern half of the sheet, the highest value being the most saline water on the sheet.

Fluorides are also relatively low compared to other parts of the Pitjantjara Lands, no analyses to date having exceeded 1.5 mg/L.

Figure 7 shows present knowledge of salinity distribution on the MANN Sheet.

HYDROCHEMISTRY

Chemical analyses are shown in Table 7.

Fingerprint diagrams were generated for all analyses. A selection of these is shown in Figure 8.

Low salinity waters around the ranges have similar chemistry. Bicarbonate is the dominant anion, followed by chloride and then sulphate.

Magnesium is the dominant anion, closely followed by sodium.

Some wells in and near mafic and ultramafic rocks show higher magnesium relative to calcium (eg 4745/35, 4745/36, 4745/37, 4745/38, 4745/92, Fig. 8).

CONCLUSIONS

1. Yields of about 0.5 to 2 L/s of moderate salinity are widely available in the northern part of the MANN sheet.

2. Alluvial aquifers in palaeochannels have potential for larger yields but will be difficult to locate and develop.

3. In the southern part of the sheet water supplies are more difficult to locate. Use of geophysical methods such as resistivity may be economic.

R E Read

R E READ
SENIOR GEOLOGIST

P. S. Tewksbury per REP

P S TEWKSBURY

REFERENCES

Read, R.E., 1989(a). Groundwater occurrence on the ALBERGA sheet. South Aust. Dept. Mines and Energy unpubl. report 89/19.

Read, R.E., 1989(b). Pitjantjatjara Lands - 1988. Drilling. South Aust. Dept. Mines and Energy unpubl. report 89/82.

Read, R.E., 1990. Groundwater occurrence on the EVERARD sheet. South. Aust. Dept. Mines and Energy unpubl. report 90/53.

Thomson, B.P., 1962. MANN map sheet, Geological Atlas of South Australia 1: 250 000 series. Geol. Surv. S. Aust.

UNESCO, 1984. Groundwater in hard rocks. Published by United Nations Educational, Scientific and Cultural Organization, 7 place de Fontenoy, 75700 Paris.

Wharton, P.H., 1984. Groundwater in the Blackstone region, in West. Aust. Geol. Survey Report No. 12 p 87-91.

Whincup, P. and Barnett, J.C., 1988. Groundwater prospecting in the arid regions of Western Australia. In Papers of the Second International Conference on Prospecting in Arid Terrain, Perth Western Australia, April 1988.

Thomson, B.P. (Compiler), 1980. Geological Map of South Australia, 1:1 000 000 scale. Dept. of Mines and Energy, Adelaide.

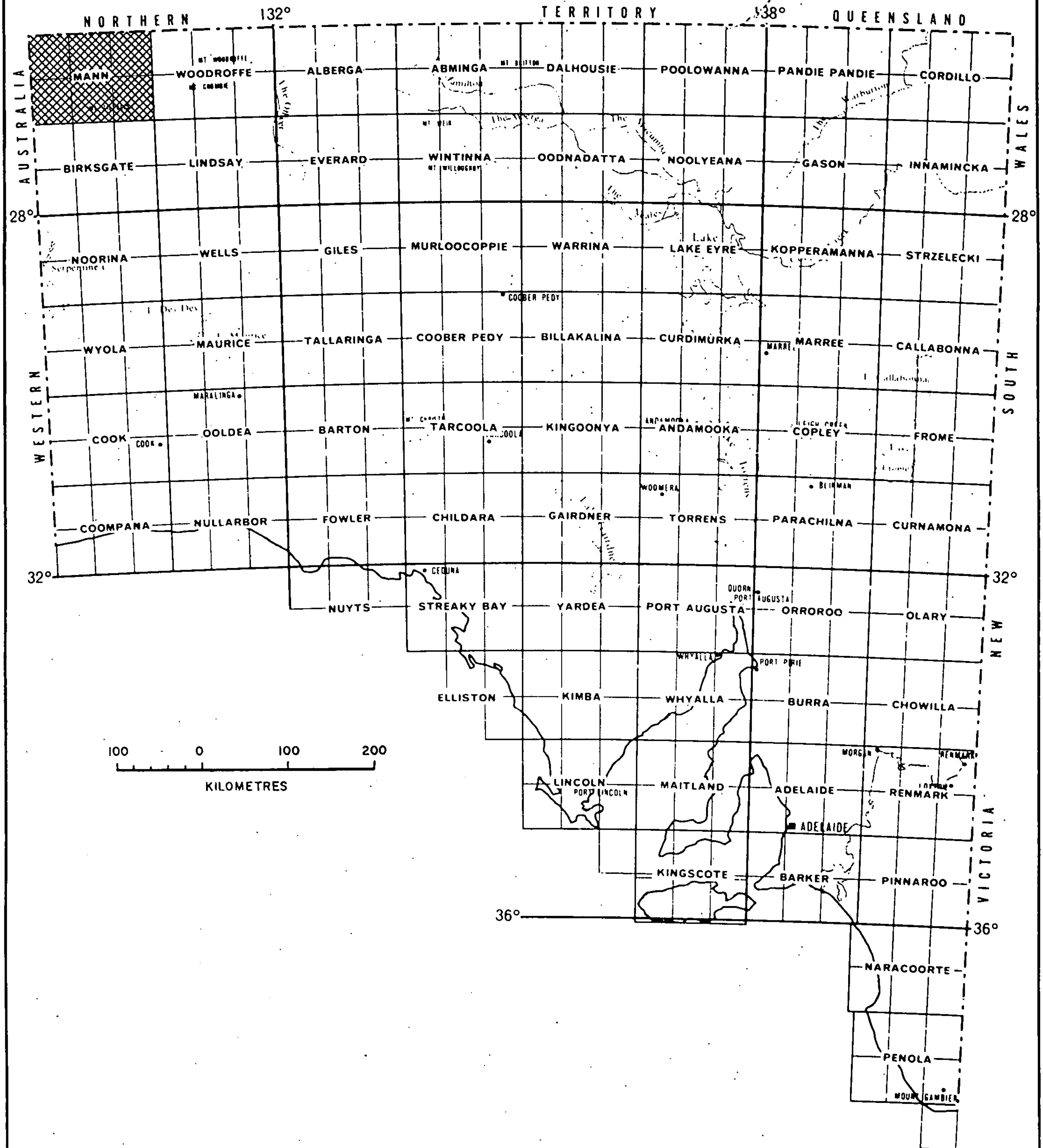


Figure 1

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE: As shown
COMPILED: R. R.	GROUNDWATER OCCURRENCE – MANN 1:250000 SHEET	DATE: MAR '91
DRN: M. B. CKD:	**LOCALITY PLAN**	PLAN NUMBER **S22036**

5268

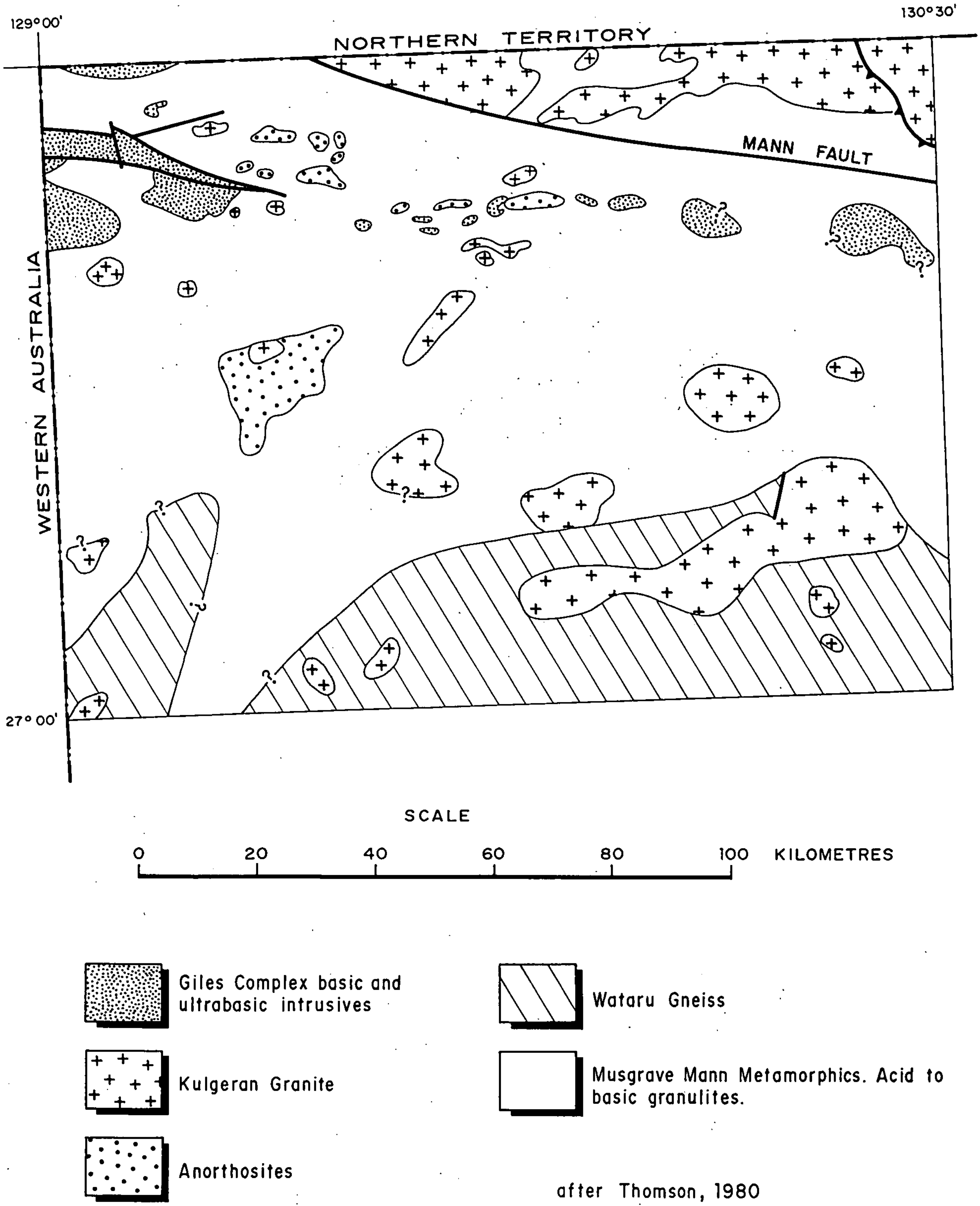


Figure 2. GROUNDWATER OCCURRENCE – MANN 1:250000 SHEET
GEOLOGICAL MAP

5268

SADME S 22037

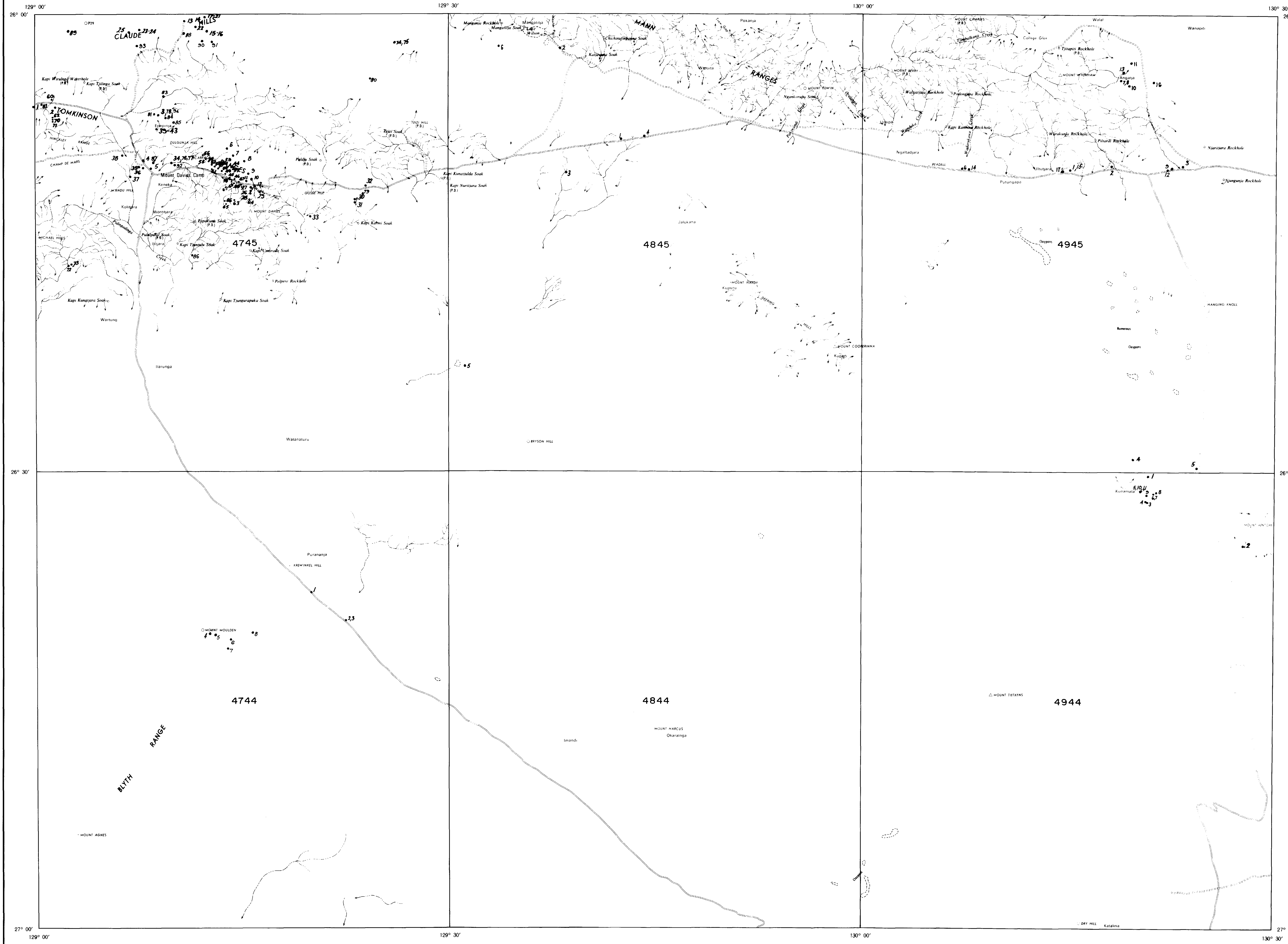


Figure 3. GROUNDWATER OCCURRENCE - MANN 1: 250000 SHEET

SCALE

0 5 10 15 20 25 KILOMETRES

WELL LOCATION PLAN

SADME

91 - 252

5268

SADME

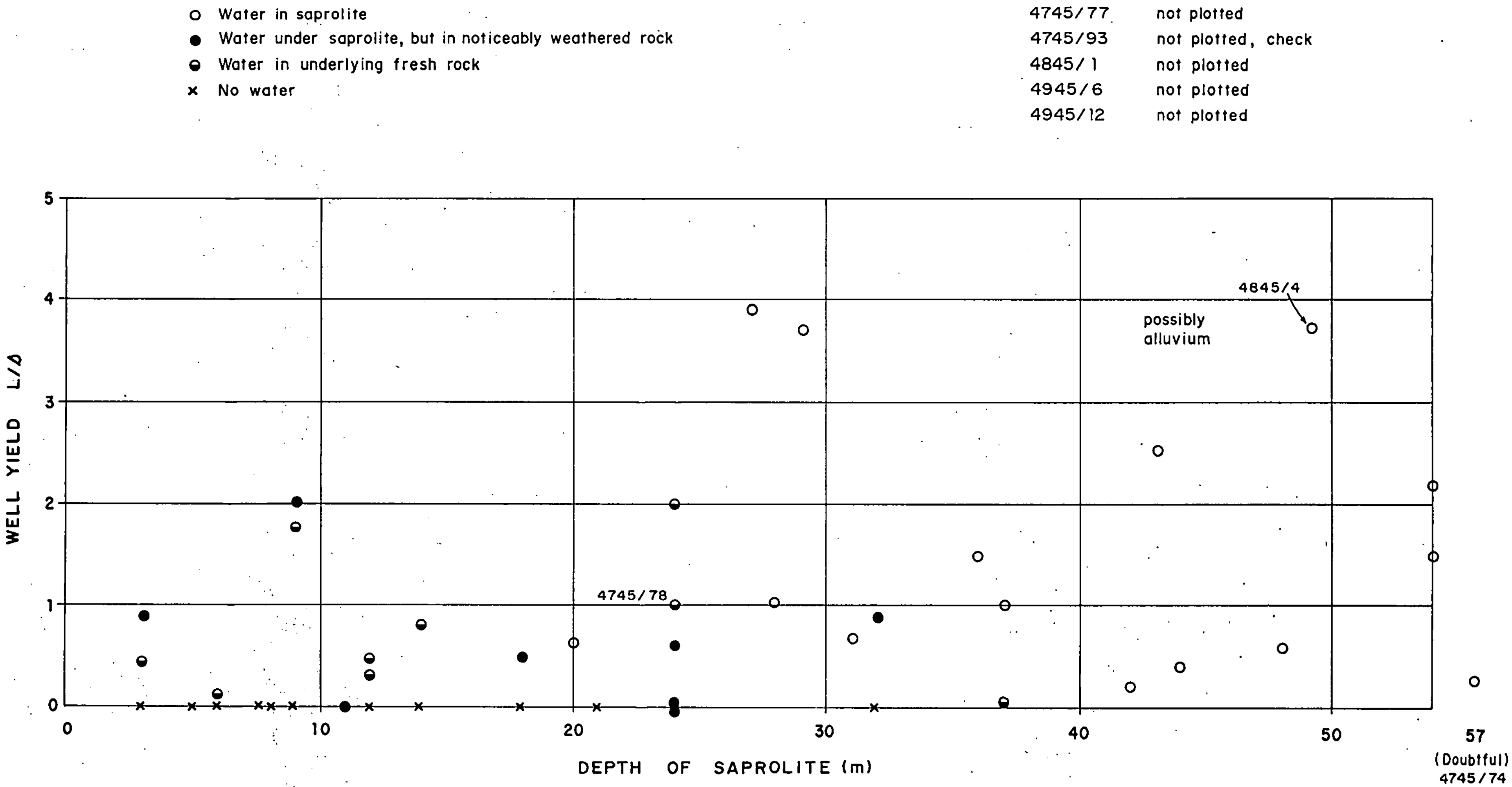


Figure 4. GROUNDWATER OCCURRENCE - MANN 1:250000 SHEET

WELL YIELDS vs DEPTH OF SAPROLITE

S 22038

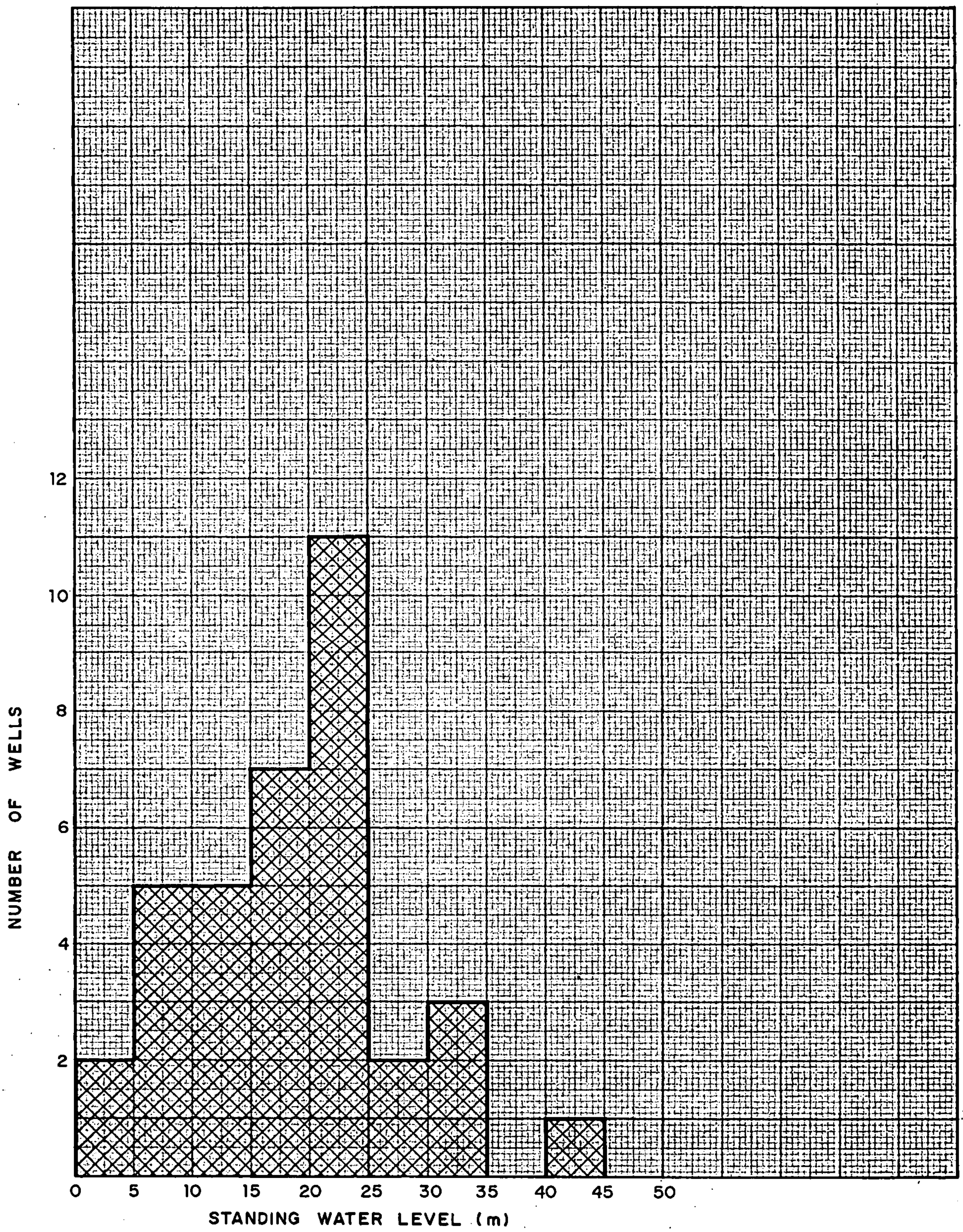


Figure 5

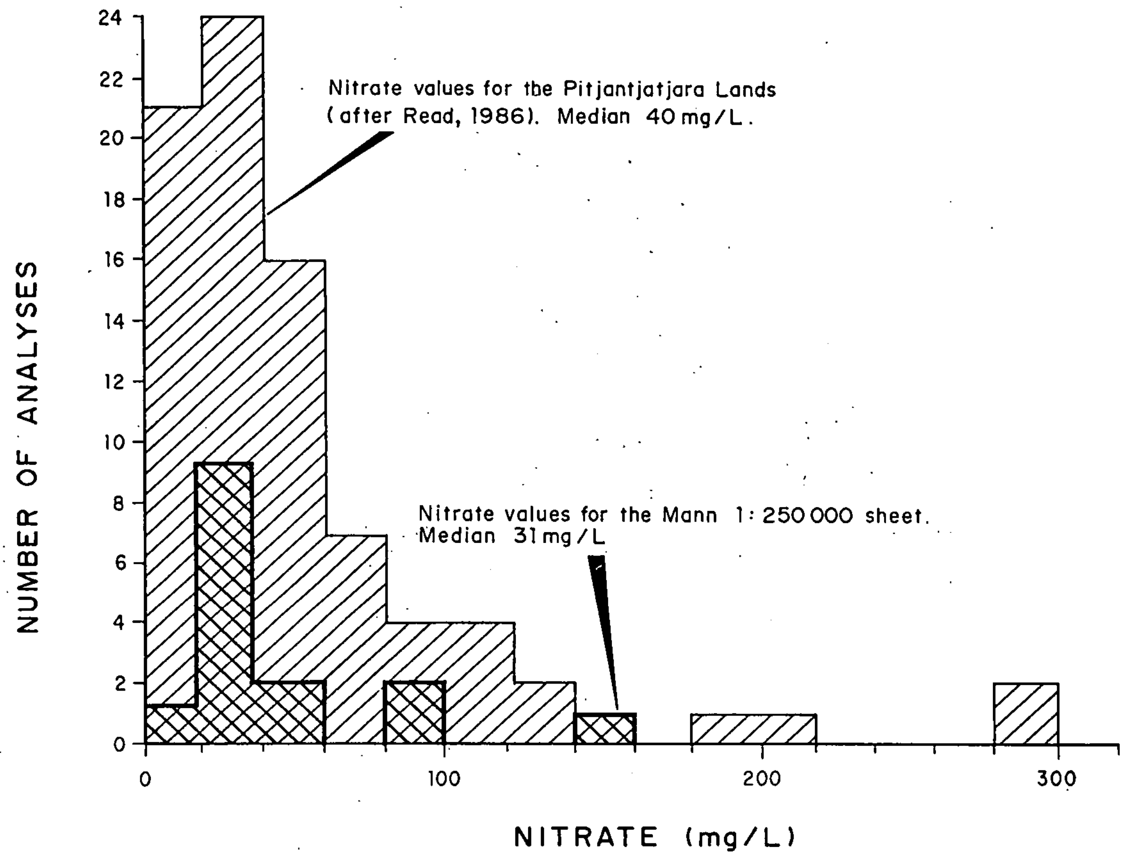
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

GROUNDWATER OCCURRENCE – MANN 1:250000 SHEET

HISTOGRAM OF STANDING WATER LEVELS

COMPILED R. R.	C.D.O.	DATE
DRAWN M. B.	SCALE	
DATE MAR '91	PLAN NUMBER	
CHECKED	S 22039	

5268



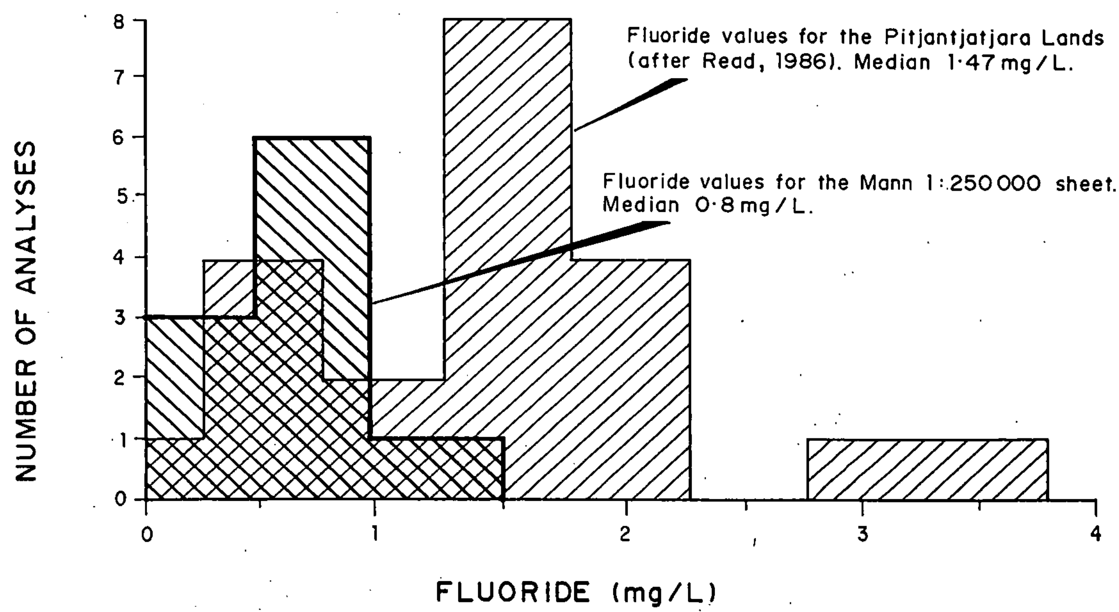


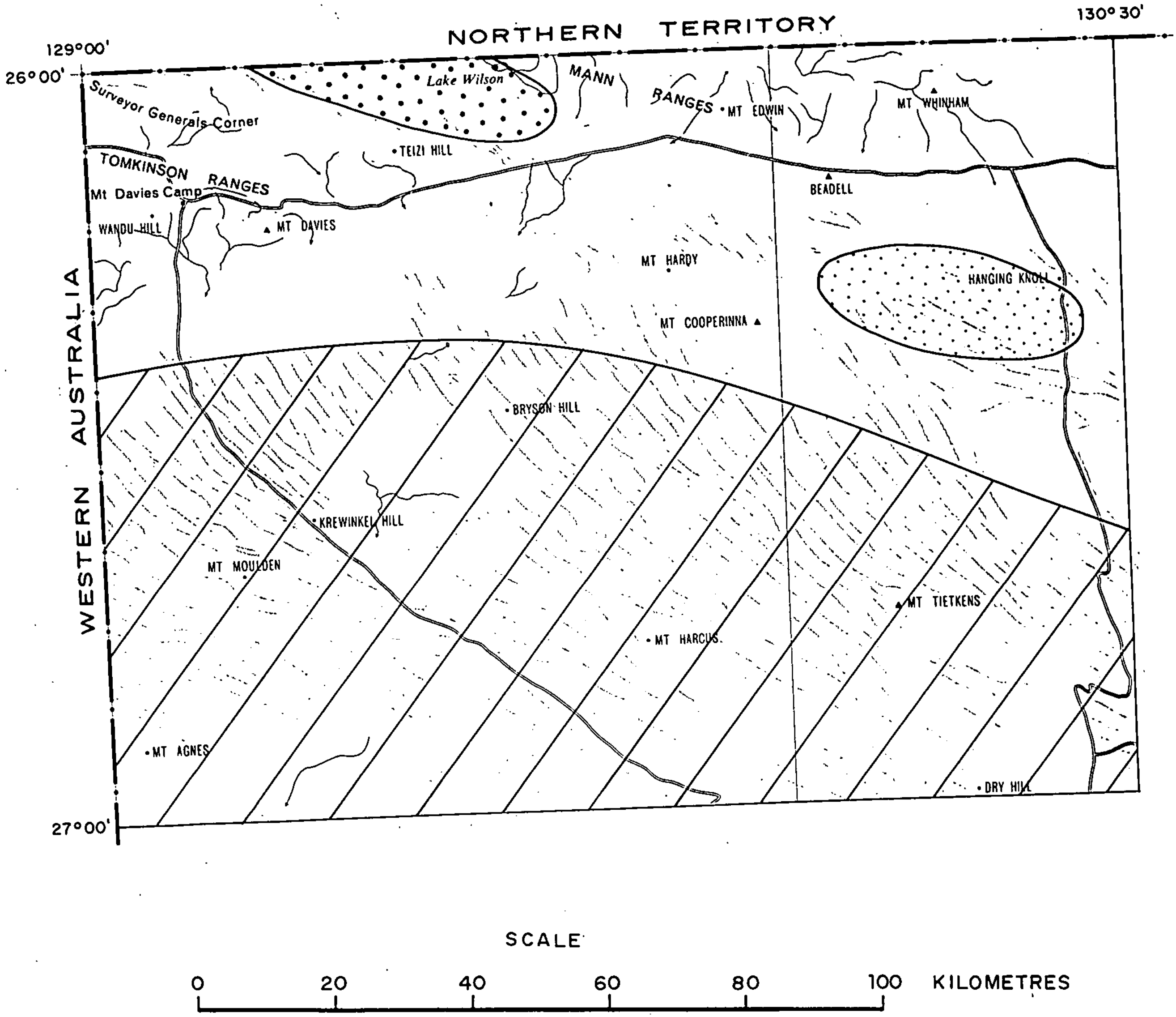
Figure 6. GROUNDWATER OCCURRENCE – MANN 1:250 000 SHEET

DISTRIBUTION OF NITRATE AND FLUORIDE CONCENTRATIONS

5268

SADME

S 22040



Salinity under 1500 mg/L and mostly under 1000 mg/L. Aquifers in both weathered and fractured rocks.

Valley between Mann and Tomkinson Ranges with salinity known to be up to 5000 mg/L.

Area suspected from the presence of claypans to contain saline water.

Great Victoria Desert. Salinity is known to range up to 6000 mg/L. Water of under 1500 mg/L may occur within 1 to 2 km of the larger hills and where soils allow better infiltration of rainfall eg. the limestone at Kunytjanu.

Figure 7. GROUNDWATER OCCURRENCE – MANN 1:250000 SHEET

GROUNDWATER PROSPECTS

5268

SADME S22041

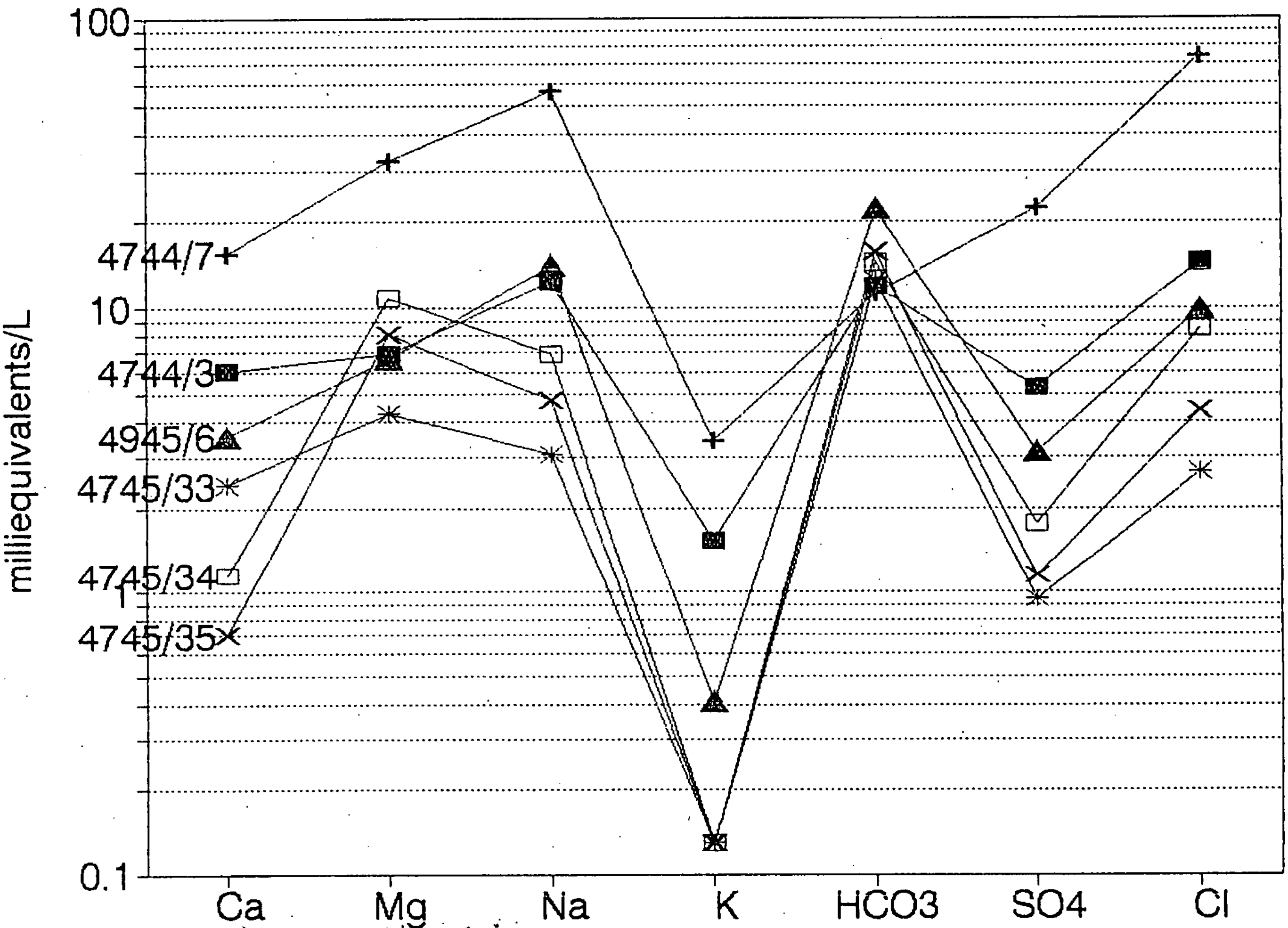


Figure 8

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE:
COMPILED: R.R.	GROUNDWATER OCCURRENCE – MANN 1:250000 SHEET	DATE: MAR '91
DRN: M.B. | CKD:	SELECTED FINGERPRINT DIAGRAMS	PLAN NUMBER S22089

5268