DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK. 79/27

SOUTH EAST WATER RESOURCES MOUNT GAMBIER AREA INVESTIGATION RESULTS OF SHORT-TERM WELL TESTS

GEOLOGICAL SURVEY

By

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SOUTH EAST WATER RESOURCES
MOUNT GAMBIER AREA INVESTIGATION
RESULTS OF SHORT-TERM WELL TESTS

ABSTRACT

During the 1971-73 investigation into the groundwater resources of the Mount Gambier area, 254 wells were sampled. Of these 77 were pumped allowing short-term (30 minutes) well tests to be performed.

The results have been analysed to give the well's specific capacity per metre open hole ($S.C._m$) and a near-well Transmissivity (T). A relationship of the form $T = 9.38\ SC_m + 465$ with a co-efficient of determination, (r^2) of 0.96 is indicated for the Gambier limestone aquifer.

INTRODUCTION

The Mount Gambier region depends upon groundwater supplies for urban, industrial and domestic purposes. In recent years the problems associated with agricultural and industrial development in an area underlain by an aquifer with local, widespread recharge have become very apparent. Numerous examples of wells pumping obviously polluted water could be found.

In the period 1971-73 the area was investigated in detail by stratigraphic drilling, monitoring of a 250 well observation grid and systematic sampling of that grid for hydrochemical and pollution studies. The results of the investigation are given in Waterhouse, 1977, and the area involved on Figure 1.

Of the 254 wells sampled, 77 were pumped for generally thirty minutes using a portable submersible pump (Waterhouse, 1973). This provided an opportunity to perform simple well tests to gain some idea of the local hydraulic characteristics of the aquifer material. Well locations are given on Figure 2.

This report tabulates the results of these tests and provides simple analyses of the results to obtain approximate hydraulic co-efficients of the near-well aquifer material (Appendix I). The original well test data are held at the Mt. Gambier Regional Office.

METHOD OF INTERPRETATION

The well tests were of short duration, generally thirty minutes or less. The discharge rate was low (approximately 220 m^3/day) and measured by recording the time taken to fill a 200 litre drum. Water level measurements were made by means of an electric probe.

These factors combined with the lack of data on well efficiency (drawdown due to well losses) precluded any but simple analyses of the results of the tests. No corrections were made to the field data for the effects of partial penetration of the aquifer nor for the reduction in Transmissivity of the aquifer near the well with phreatic surface decline. Consequently it can be assumed that the values quoted for Transmissivity are on the conservative side.

The field data were split into two groups. The first showed the approach to steady-state conditions where the change in drawdown with time had become negligible. These tests were analysed by the method of Logan (1964). The second group showed unsteady-state flow where the change in drawdown with time was measurable. These tests were analyses by the graphical method of Jacob (Cooper and Jacob, 1946).

These analytical methods and the assumptions underlying their applicability are given in Appendix 2.

RESULTS

The results of the well tests and their subsequent analyses are tabulated in Appendix 1.

The normal well parameter of Specific Capacity (S.C.) or yield per unit drawdown, has been modified to give S.C. per metre open hole ($S.C._m$). This allows more realistic inter-well comparisons and comparison with the calculated Transmissivity value for each well.

A useful relationship developed for an aquifer in a particular area is that between well $S.C._m$'s and aquifer Transmissivity. Single drawdown values at a known pumping rate in a well can then be used to estimate the order of magnitude of aquifer Transmissivity. In reconnaissance surveys this can provide most useful data at negligible cost and in a small space of time.

For the well tests performed the values of Transmissivity calculated for each well were plotted against the wells $S.C._m$ The plot is given in Figure 3.

The relationship between the two values was investigated by both linear regression and by fitting a power curve to the data. For the first analysis all data points were included and for the second only those with $S.C._m$ values less than 200 m^3/day/m per metre open hole (omitting the few obviously questionable data points). This was done because of the large concentration of points in lower $S.C._m$ values. The results are tabulated below. The co-efficient of determination indicates how closely the equation fits the raw data: it lies between 0 and 1 and the closer r^2 is to 1, the better the fit.

LINEAR REGRESSION

Equation of the form $Y = MX + b$

DATA USED	NUMBER OF DATA POINTS	EQUATION	COEFFICIENT OF DETERMINATION r^2
ALL	34	$T = 9.38\ SC_m + 465$	0.96
S.C.$_m$ <200	31	$T = 9.78\ SC_m + 317$	0.21

POWER CURVE FIT
Equation of the form $Y = ax^b$ $(a>0)$

DATA USED	NUMBER OF DATA POINTS	EQUATION	COEFFICIENT OF DETERMINATION r^2
ALL	34	$T = 32.15\ SC_m^{0.84}$	0.78
S.C.$_m$ <200	31	$T = 35.81\ SC_m^{0.79}$	0.57

Thus, over the range of values likely to be encountered the equation $T = 9.38\ SC_m + 465$ would appear to give the best approximation for Transmissivity in a reconnaissance survey athough this equation limits T effectively to values >465 m^3/day/m. For values of SC_m less than 50, the power curve $T = 32.15\ SC_m^{0.84}$ gives a reasonable approximation of the Tramsmissivity.

An alternative method of estimating Transmissivity using a family of curves derived from the results of tests on wells producing water from the Gambier limestone is presented in appendix III.

ACKNOWLEDGEMENTS

The author would like to thank D. Lang and D. Boult for help in preparing the table in Appendix I and to P.C. Smith

for supplying the geological unit opposite the open hole section of each well.

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APPENDIX 1

TABULATION OF WELL DATA AND TEST RESULTS

TABULATION OF WELL DATA AND TEST RESULTS

Well Obs Code*1	Unit State No.	Total Depth (m)	Casing Depth (m)	Water Level prior to test (m)	Final drawdown's (m) at time t(mins)	Pumping rate (Q) m^3/day	Q/s per metre open hole *2	Transmissivity m^3/day/m	Geological Unit *	Remarks
YOU3	70220040W03401	16	5.39	7.653	-	(221)	-	-	G +D	Sucked air after about 140 lts.
MIN 6	70220010W01374	10		3.359	0.631(28)	221	52.7	2890(J)	N.A.	Motor accidently switched on -SWL may not be valid. Pump set 9m. Water clear.
MIN 7	70220010W01366	8	6.25	0.415		221			B	Bore pumped dry in 17 seconds SWL not accurate. Pump set 5m
BLA 5	70223300W02801	35	13.26	23.886	1.196(30)	221	16.42	500(J)	B + G	Bore pumped fairly dirty at first but cleaned reasonably well. Pump set at 33.5 m.
BLA 6	70223300W02828	44	5.7	51.332	2.94(30)	221	6.05	190(J)	G	Bore very silty at beginning. Did not clear very well during pumping - combined fine silt and a reddish sand. Pump set at 33m.
BLA 8	70220020W00291	42	8.26	32.140	5.91(30)	221	3.46	45(L)	B + G	Water fairly silty at start but cleared somewhat during tes (white). Pump set 39.3m (would not go below 40m)
BLA 16	70223300W02794	40	6.21	29.114	4.313(30)	221	5.18	80(J)	G	Static water level only approx. due to pump being switched on. Water silty at start, cleared somewhat during test. Pump set 39m.
BLA 17	70223300W02846	36	4.52	26.404	-	(221)	2.59		G	Sucked air in 5 minutes. Pump set 35.8m.
BLA 18	70223300W02910	42	15.07	30.219		(221)	1.73		G	Pumped air in 2 minutes. Pump set 40.5m?
BLA 20	70220020W00059	42	12.35	29.515	0.035(22)	221	443	7700(L)	G	Water cleared in about 10 min. Pump set 41m. Test stopped since water level stabilized.

BLA21	70220020W00076	36	6	24.267	1.73(30)	221	11.2	160(L)	G	Water milky, cleared somewhat during test. Pump set 32.3m (would not pass 33.5m)
BLA22	70220020W00081	58	35.58	37.517	0.106(30)	221	102	1660(J)	G	Water milky at first, clearing after 5 minutes. Pump set 48 m.
LA27	70223300W02773	39	37.79	25.720	1.20(30)	270	186	280(L)	G	Water light brown initially but clear by end of test. Continuous flow of small air bubbles. Pump set 35.8m.
BLA30	70220020W00052	49	11.12	38.765	2.17(30)	221	10.4	120)L)	B + G	First attempt bore pumped dry in 2 minutes withmuch sand production. Rapid recovery between tests. Sand still produced in second test but water milky with silt at end. Pump set at 42.2m, hole collapsed at 42.9m.
BLA31	70220020W00072	42	6.60	23.085	9.91(30)	221	0.86	140(J)	B + G	Water very clear. Odd bryozoal fragments. Pump setting 43m.
BLA38	70223300W02721	36	1.05	23.687	0.68(30)	221	27	400)L)	G	Water milky, cleared in 15 minutes. Pump setting 35m.
BLA39	70223300W02719	45	6.30	25.374	-				G	Pump stopped through silted parts - water very silty. Pump setting 43m.
BLA40	70223300W02713	44	6.17	33.388	8.4(5)	221	2.59	-	G	Bore pumped dry in 5 minutes water slight grey tint. Drawdown figures approximate pump setting 42m.
BLA41	70220030W02566	37	1.80	24.160	4.91(30)	221	346	30(J)	G	Water cleared after 15 minutes. Pump setting 36.4m.

BLA42	70223300W02823	40	6.43	25.954	1.438(30)	221	11.2	190(L)	G	Water very silty initially cleared somewhat during test. Pump setting 38m.
GAM47*	70222700W00838	22.3		3.176	0.868(5)	221			N.A.	Sucked air at 5 minutes. Pump setting 4m. Approx. 1m diameter well.
BLA48	70220030W02489	11.1		8.567	1.92(16)	221				Circular well 1.2m diameter sucking air at 16 minutes.
BLA52	70220030W02570	42	12.21	24.674	4.33(30)	221	2.59	130)J)	G	Water clear after 15 minutes. Minor sucking of air at 29min Pump setting 29m.
BLA56	70220030W02433	22	16.86	16.880					G	Bore did not pump water.
BLA65	70220030W02597	34	3.05	18.827					G	Pumped dry in 130 seconds. (After 360 litres). Water had grey discoloration. Pump setting 32.3m.
BLA67	70220020W00071	60	20.03	42.741	2.124(35)	221	2.59	330(J)	B + G	Water dark brown initially. Water levels started to recover after 25mins, water still discoloured. Pump setting 47.9m
BLA69	70220030W02415	16	5.41	4.210	10(1.3)	221	1.73		B + G	Pump sucked air after 80 seconds. Water reddish brown.
BLA71	70220030W02411	44	11.19	34.721	0.011(30)	221	2170	25 000(L)	G	Water crystal clear. Pump setting 43.5m. Stable drawdown
BLA72	70220030W02498	45	5.92	25.970					G + D	Pumped air after about 60 litres pumped. Pump setting 30.3m, would not go below 31m
BLA76	70223300W02732	139	5.94	39.357	0.115(30)	221	19?	2800(J)	G	Water murky initially but soon cleared. Pump setting 48m.
BLA77	70223300W02785	132.5 (cement plug at 90.5m)	11.4	25.808	0.009(30)	221?	380?	30 000(L)	G + T	Water murky initially but soon cleared. Pump setting 38m.

BLA78	70220030W02459	15.9	None	3.845	9.20(2)	221	(1.73)		N.A.	Pumped air at 2.2. mins. Pumped about 100 litres.
BLA80	70220030W02360	14	12.27	3.803					D	Intake ports partially blocked Pumped 15 minutes, discoloured water, rate about 1.3 l/sec.
BLA81	70223300W02710	42	6.40	27.305	1.1(30)	221	13.8	250(L)	G	Water milky, slowly clearing, some fine arenite. Pump set 38.9m, would not go below 39.5
BLA82	70223300W02864	42	12.42	28.635	1.638(30)	221	10.4	280(J)	G	Water near clear. Pump settin 38m.
BLA84	70220030W02460	64	5.66	14.330	0.11(30)	221	45	2500)L)	G + (D?)	Pump setting 25m.
BLA85	70220030W02397	35	23.93	16.605	0.25(30)	221	80	2850(J)	G	Pump setting 33.5m
BLA86	70220030W02412	47	6.20	32.080					G + D	Probe stuck after start of tes Pumped 180 litres in 90 seconds then pumped air. Pump setting 46m. Water discoloure
BLA87	70220030W02529	35		16.540					G	Sucking air in 5 minutes. Pro stuck. Pump setting 38m.
GAM 8	70223400W01532	35	25.66	25.325	0.55(30)	221	43	440(J)	G	Water silty, clearing during test. Pump setting 34m
GAM 9	70220020W00284	32	6.40	22.129	0.57(30)	221	40	1400(J)	G	Only small amount of silt in water after test. Pump settin 31m.
GAM12	70220020W00293	32	6.25	23.293	2.396(30)	221	10.4	510(J)	G	Water slightly silty by end of test. Pump setting 31m.
GAM18	70223400W01682	46	29.62	34.823	4.153(15)	221	5.18	65(L)	G	Pump switched off by overload- No obvious reason. Water slightly silty. Pump setting45
GAM19	70223300W02818	46	20.13	24.755	7.113(30)	221	1.73	42(J)	G	Water cleared up completely but some did reappear after 20 minutes pumping. Pump setting 40m
GAM20	70220020W00261	32	5.30	20.730	0.797(30)	221	25	930)J)	G	Water cleared during test, only slightly silty at end. Pump setting 30m.
GAM21	70220020W00252	30	5.94	20.641	1.057(30)	221	22.5	180(J)	G	Water cleared throughout test but still contained fine silt. Pump set 29.1 m.

GAM22	70220020W00249	30	10.62	20.803	3.383(30)	221	6.9	330(J)	B + G	Water clear in 5 minutes. Pump setting 31m.
GAM23	70223400W01538	38	24.5	27.663	9.34(5)	221	1.73	(28(L))	G	Pumped air at 5 minutes. Water light brown, silty. Pump setting 37m.
GAM28	70223400W01687	38	27.76	29.644		221		(10(J))	G	Bore pumped dry in two minutes Pump setting 37m. Recovery test performed.
GAM29	70223400W01686	36	5.8	21.919					G	Bore pumped dry in 3 minutes. Recovery test started imme-diately. Pump setting 35m
GAM30	70220020W00264	36	11.99	25.600	0.894(30)	221	24.2	curved plot	G	Water quite silty throughout test. Pump setting 34.4m
GAM37	70222700W00813	20	17.37	10.312					G	Pump only pumping about 1 l/sec to 3 minutes then rate increased (water very discolou-red then decreased again after 11 minutes - test stopped. Pump set 16m, hole bottom 16.5m
GAM48	70222700W00840	10	10.00	5.374					B	Pumped dry in 20 seconds. Pump setting 7.5m, Bore depthed at 8.5m
GAM52	70220020W00161	30	11.52	22.908	0.009(20)	221	3465	30 000(L)	G	Water cleared in 10 minutes, stopped at 20 minutes, water level equilibrating. Pump setting 29m (Driller recorded depth of bore as 28m)
GAM56	70223400W01534	34	13.76	22.670	4.890(30)	221	4.32	20(J)	G	Water cleared during test, stil silty at end. Pump setting 30.7 m
GAM58	70223400W01537	42	6.10	24.260	4.260(30)	221	2.59	230)J)	G	Water very silty, cleared somewhat, Pump setting 40m
GAM59	70223400W01539	40	6.05	22.918					G	Pump switched off after 16 minutes - silted up, breathing bore. Air temperature 19.5°C
GAM60	70220020W00283	40	5.74	22.455	1.126(30)	221	11.2	240(L)	G	Water slightly silty at end of pumping. Pump setting 39m

GAM61	70223300W02797	40	6.30	24.290	14.48(6)	221	0.86		G	Pump sucked air at 6½ minutes. Water very silty. Pump setting 39 m
MAC25 (cave)	70210010W01015			3.425	0.033(230)	221			G	Cave.
MAC35 (M.G.4)	70220030W02283	218	6.55	6.876	3.275(30)	221	0.32?	170(J)	G	Water still milky after test. Pump setting 20 m. Total depth at time of pumping unsure.
CAR9 (M.G.5)	70220020W00522	226	6.27	20.136	0.405(30)	221	2.65?	670)L)	G	Only trace of silt at 30 min Pump setting 34m. Total depth at time of pumping unsure
CAR10 (M.G.6)	70210010W01099	300	6.43	1.226	1.430(35)	221	0.53?	Boundary indicated?	G	Water reddish brown, fine suspended matter. Pump setting 16m. 8 inch casing. Total depth at time of pumping unsure.
CAR11 (M.G.7)	70210010W01058	147	6.23	0.656	1.149(60)	221	1.37?	"	G + T	Water grey to light brown. Pump setting 16m. Total depth at time of pumping unsure.
CAR22 (2x)	70220020W00538	28.4	22.2	17.300	2.542(30)	221	13.8	110(L)	G	Water clearing from brown until 10 minutes when water went quite milky Pump setting 27m, hole depth approx. 28 m
CAR23	70210010W01093	15.3 approx	well 1.25x0.6m	8.230	1.532(13)	221	21		G	Pump sucked air at 13.15 min. Water brown, clearing during test. Pump setting 9.8 m

REMARKS

*1 WELL OBSERVATION CODE: MADE UP OF A THREE LETTER CODE REPRESENTING THE HUNDRED IN WHICH THE WELL OCCURS AND A SEQUENTIAL NUMBERING SYSTEM WITHIN THE HUNDRED (REFER FIGURE 2 FOR LOCATION)
BLA: Hd. BLANCHE: CAR: Hd. CAROLINE: GAM: Hd. GAMBIER
MAC: Hd. MACDONNELL: MIN: Hd. MINGBOOL: YOO: Hd. YOUNG

*2 Q/S per metre open hole: The specific capacity of the well divided by the open hole length. Pumping rate (Q) in m^3/day, drawdown (s) in m. Note that either the bottom of the well casing or the prepumping water level which ever was the deepest, was used to calculate the length of open hole.

*3 Geological Unit: (compiled by P.C. Smith, Mt. Gambier Regional Geologist)
B : Bridgewater Formation
G : Gambier Limestone
T: Transition Beds (= Lacepede Frm, Kongorong Sands)
D: Dilwyn Formation (= Knight Group Tartwaup Formation)
NA: Not available

APPENDIX 2

METHODS OF INTERPRETATION

APPENDIX 2

METHODS OF INTERPRETATION

UNSTEADY-STATE

Method: Cooper and Jacob, 1946.

Assumptions underlying method:

.... The aquifer has a seemingly infinite areal extent.

.... The aquifer is homogeneous, isotropic and of uniform thickness over the area influenced by the test.

.... Prior to pumping, the phreatic surface is (nearly) horizontal over the area influenced by the test.

.... The aquifer is pumped at a constant discharge rate.

.... The pumped well penetrates the entire aquifer and thus receives water from the entire thickness of the aquifer by horizontal flow (not generally satisfied).

.... The aquifer is unconfined.

.... The flow to the well is in an unsteady state.

.... The water removed from storage is discharged instantaneously with decline of head, i.e. there are no delayed yield effects.

.... The well diameter is extremely small i.e. the storage in the well can be neglected.

.... The values of u are small ($u<0.01$) i.e. r is small and t is large.

Analysis: A graph of drawdown against the log of time is plotted and a straight line drawn through the points. The Transmissivity is given by -

$$T = \frac{2.3Q}{4\pi\Delta s}$$

where Δs = drawdown difference per log cycle.

STEADY-STATE

Method: Logan (1964)

Assumptions: The first six as for unsteady-state.

Analysis: Logan based his reasoning on the Thiem formula for a confined aquifer i.e.

$$T = \frac{2.30 \log}{2\pi S_{mw}} r_{max}/r_w$$

where r_w = radius of the pumped well

r_{max} = radius of influence

s_{mw} = maximum drawdown in the pumped well.

It can be seen that the accuracy of the calculation depends only on the accuracy of the measurement of S_{mw} (on which well losses may have a substantial influence) and on the accuracy of the ratio r_{max}/r_w. Whilst in our situation r_{max} is not known and may vary significantly, the logarithm of the ratio will be subjected to much less variation. Assuming average conditions of radii, a value of 3.33 for the log-ratio may be accepted as a rough approximation.

Substitution into the above formula yields

$$T = \frac{1.22Q}{S_{mw}}$$

For unconfined groundwater S_{mw} should be substituted by $S'_{mw} = S_{mw} - S^2_{mw}/ 2D$ where D = aquifer thickness. This was not done.

Note that the use of the above formula can yield results up to 50% out and hence its usage is limited to first-time round (reconnaissance) approximations.

APPENDIX 3

Gambier Limestone: Estimation of T

from 10 mins drawdown.

APPENDIX III

Gambier Limestone: Estimation of T from 10 min drawdown

1. 29 well tests at 220 m^3/day for 30 min were analysed by Jacob's straightline method.

T was determind for each well
S_{t10} min was determined for each well
S_{t1} min was determined for each well

2. S_{t1} m was regarded as well loss. S_{t1} m was plotted (linear scale) versus T (log scale).

The relationship $T \approx 2600\ e^{-0.96\ S_{t1}\ m}$. can be deduced from the plot. (This equation places a (maximum) value of 2600 on T).

3. For Q = 220 m^3/day i.e. 0.153 m^3/min and assuming that the well equation is of the form -

$$S_t = b \log_{10} t + CQ^2 \quad \text{(i.e. 'a' is negligible)}$$

and that S_{t1} m is essentialy the well loss CQ^2 it is possible to estimate C for the Q = 0.153 m^3.

i.e. $S_{t1\ m} = CQ^2$

therefore $C = \dfrac{S_{t1\ m}}{Q^2}$

Using the S_{t1} min value for various values of T, a corresponding C can be calculated for each transmissivity.

T m^3/day/m	C (for Q in m^3/min)
10	243
50	171
100	141
500	72.6
1000	42.7
2000	11.5

4. Since $T = \dfrac{0.183Q}{\Delta s}$ it is possible to calculate Δs for any value of T & Q (in m^3/day).

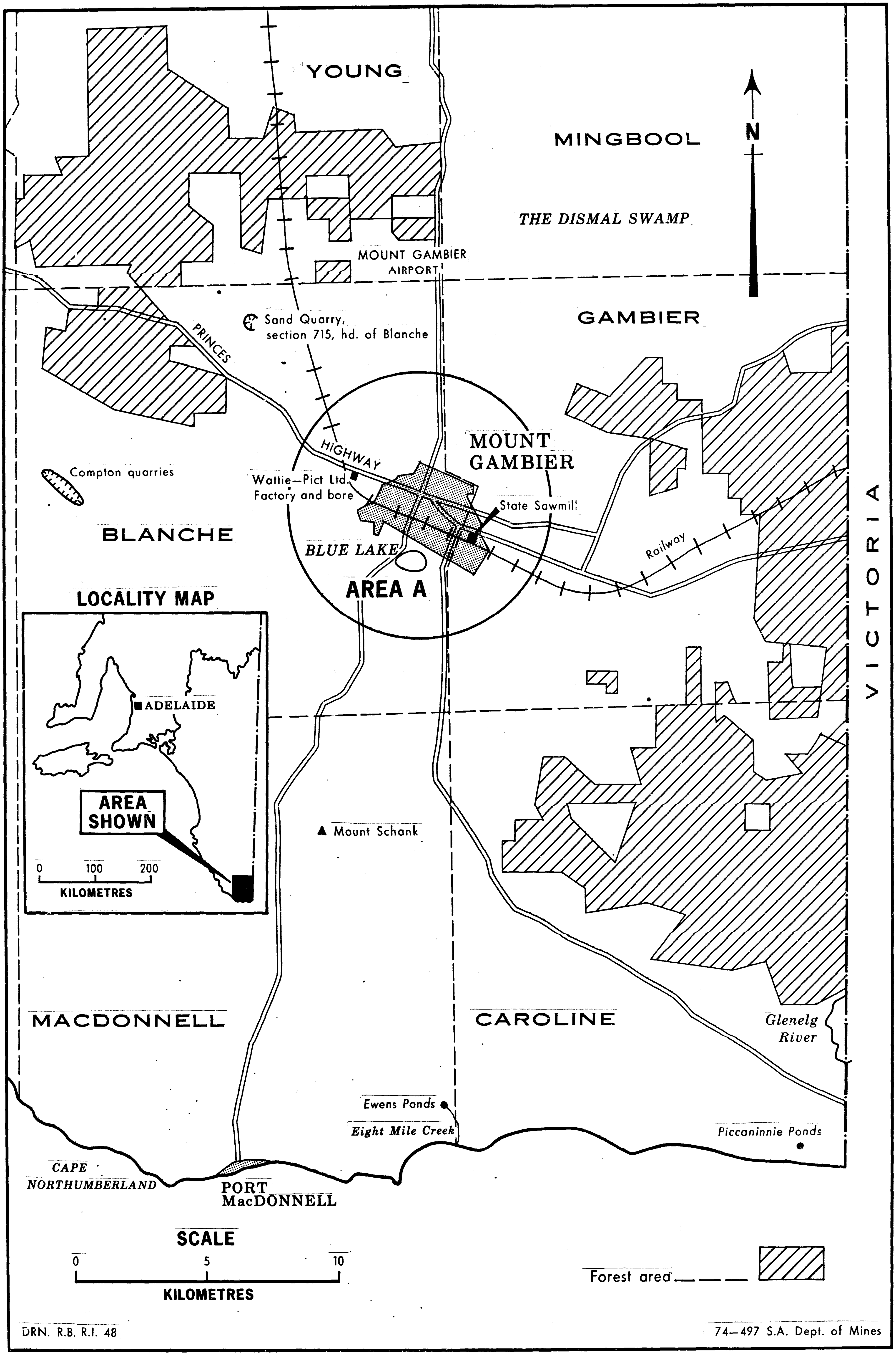
$$\Delta s = \frac{0.183Q}{T}$$

5. The 10 minute drawdown S_{t10} m is obtained for each transmissivity and a range of Q values by adding Δs to S_{t1} m. The resulting family of curves is plotted on log/log paper, with drawdown at 10 min (S_{t10}) and discharge rate Q (m^3/min) as axes.

It is possible now to estimate transmissivity from a single pair of WL observations coupled with a discharge rate.

i.e. Q m^3/min
SWL
S_{t10} min

for wells with approximately 10 metres of saturated Gambier Limestone in an area similar to the area from which the results were obtained.


YOUNG
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Sand Quarry, section 715, hd. of Blanche
PRINCES
HIGHWAY
MOUNT GAMBIER
Compton quarries
Wattie—Pict Ltd. Factory and bore
State Sawmill
BLANCHE
BLUE LAKE
Railway
AREA A
VICTORIA
LOCALITY MAP
ADELAIDE
AREA SHOWN
0
100
200
KILOMETRES
Mount Schank
MACDONNELL
CAROLINE
Glenelg River
Ewens Ponds
Eight Mile Creek
Piccaninnie Ponds
CAPE NORTHUMBERLAND
PORT MacDONNELL
SCALE
0
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10
KILOMETRES
Forest area
DRN. R.B. R.I. 48
74—497 S.A. Dept. of Mines

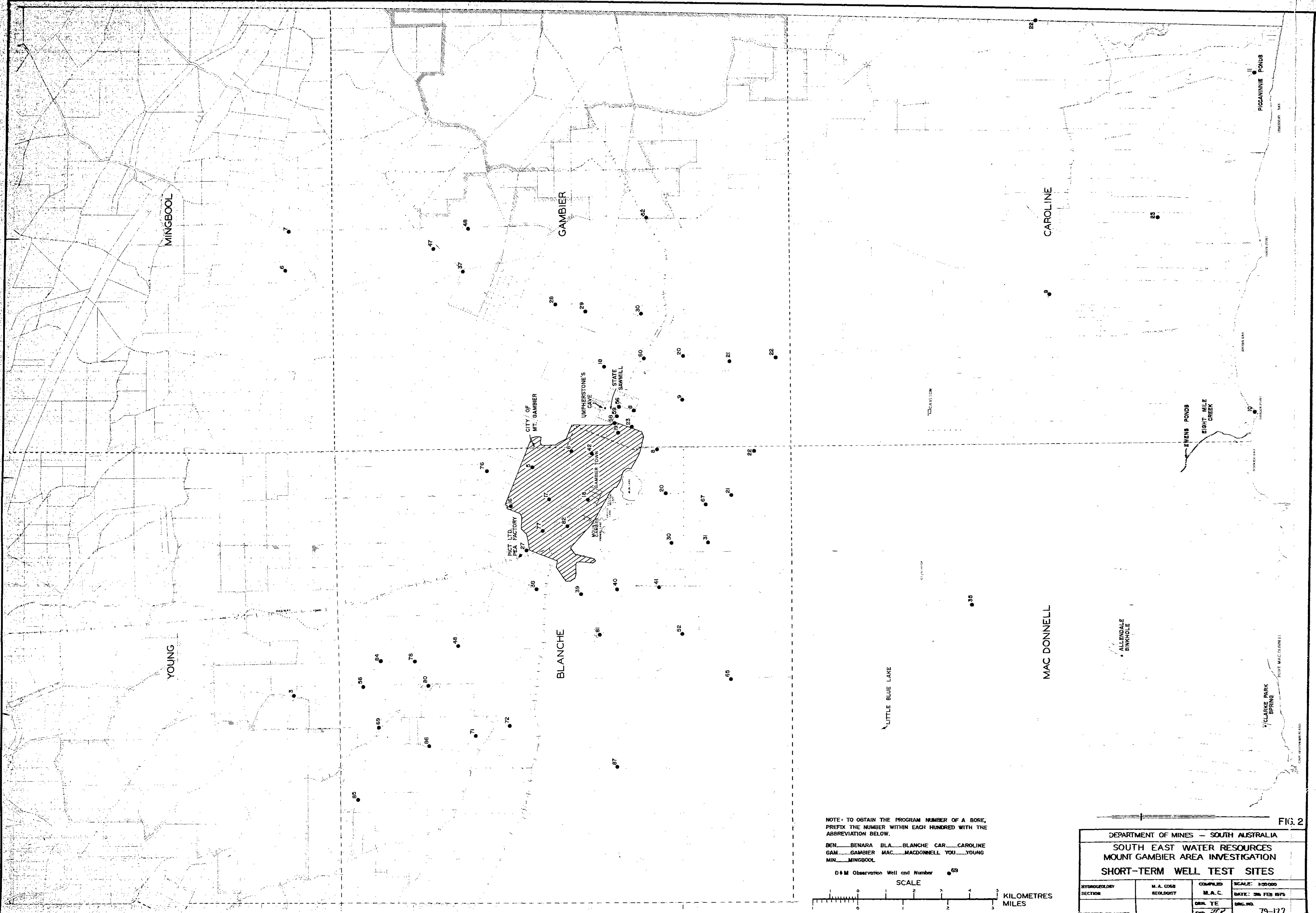
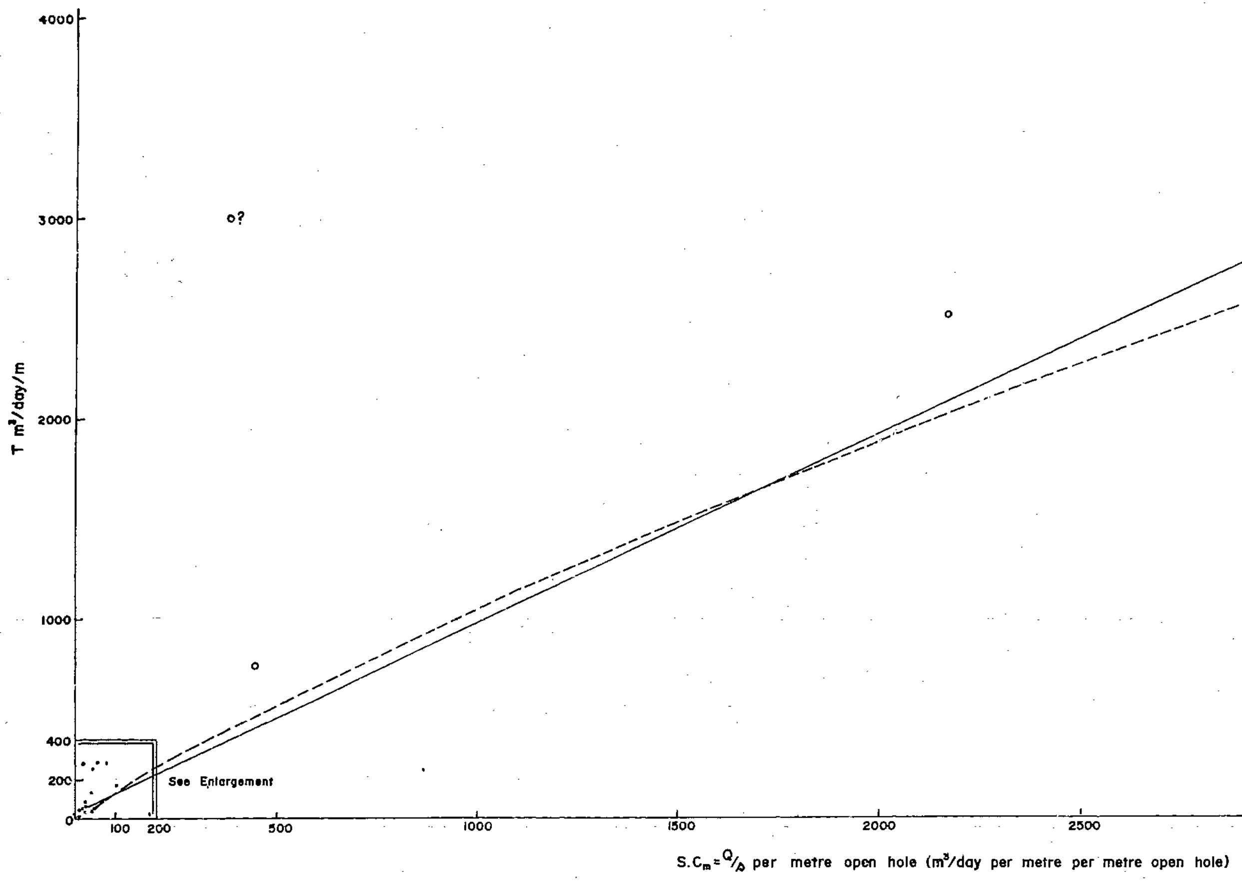


FIG. 2

DEPARTMENT OF MINES — SOUTH AUSTRALIA			
SOUTH EAST WATER RESOURCES MOUNT GAMBIER AREA INVESTIGATION			
SHORT-TERM WELL TEST SITES			
HYDROGEOLOGY SECTION	M. A. COBB GEOLOGIST	COMPILED M.A.C.	SCALE: 1:50 000
			DATE: 5th FEB 1975
DIRECTOR OF MINES		DRN. TE	DRG. NO. 79-122
		CKD.	



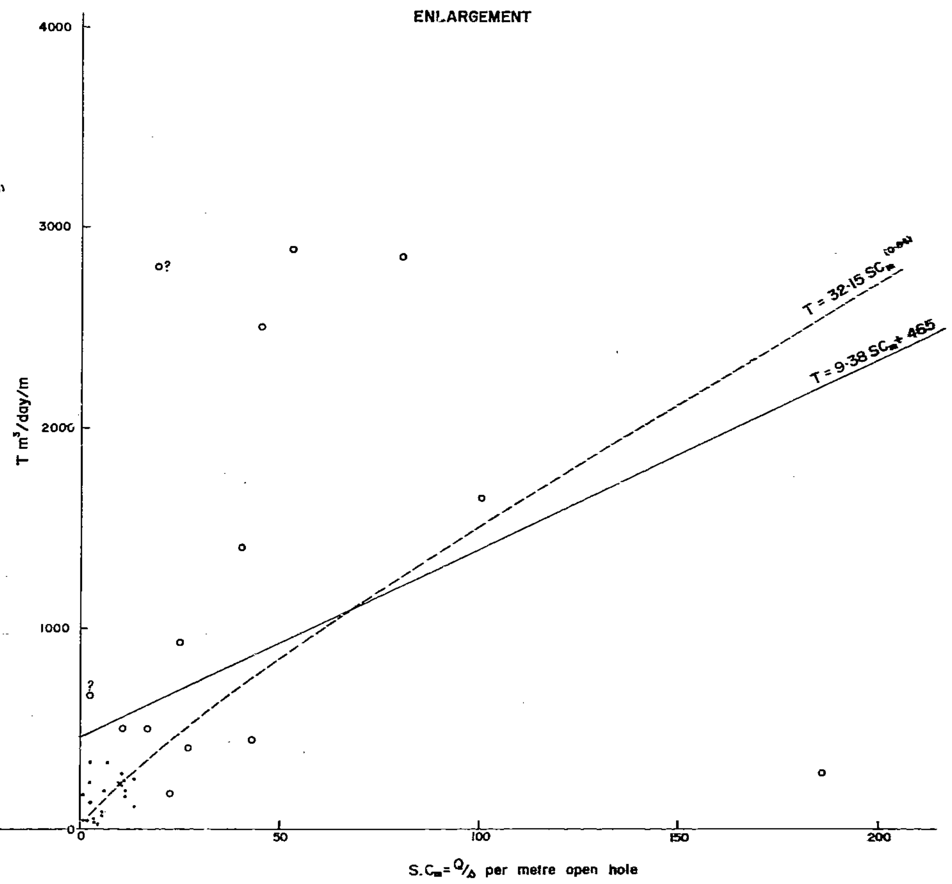


FIG. 3

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE —
COMPILED M.A.Cobb	SOUTH EAST WATER RESOURCES MT. GAMBIER AREA INVESTIGATION SHORT-TERM WELL TESTS	DATE 5th FEB. 1979
DRN TE / CKD W.D.R.	SPECIFIC CAPACITY/m OPEN HOLE v TRANSMISSIVITY	PLAN NUMBER 79-123

1174

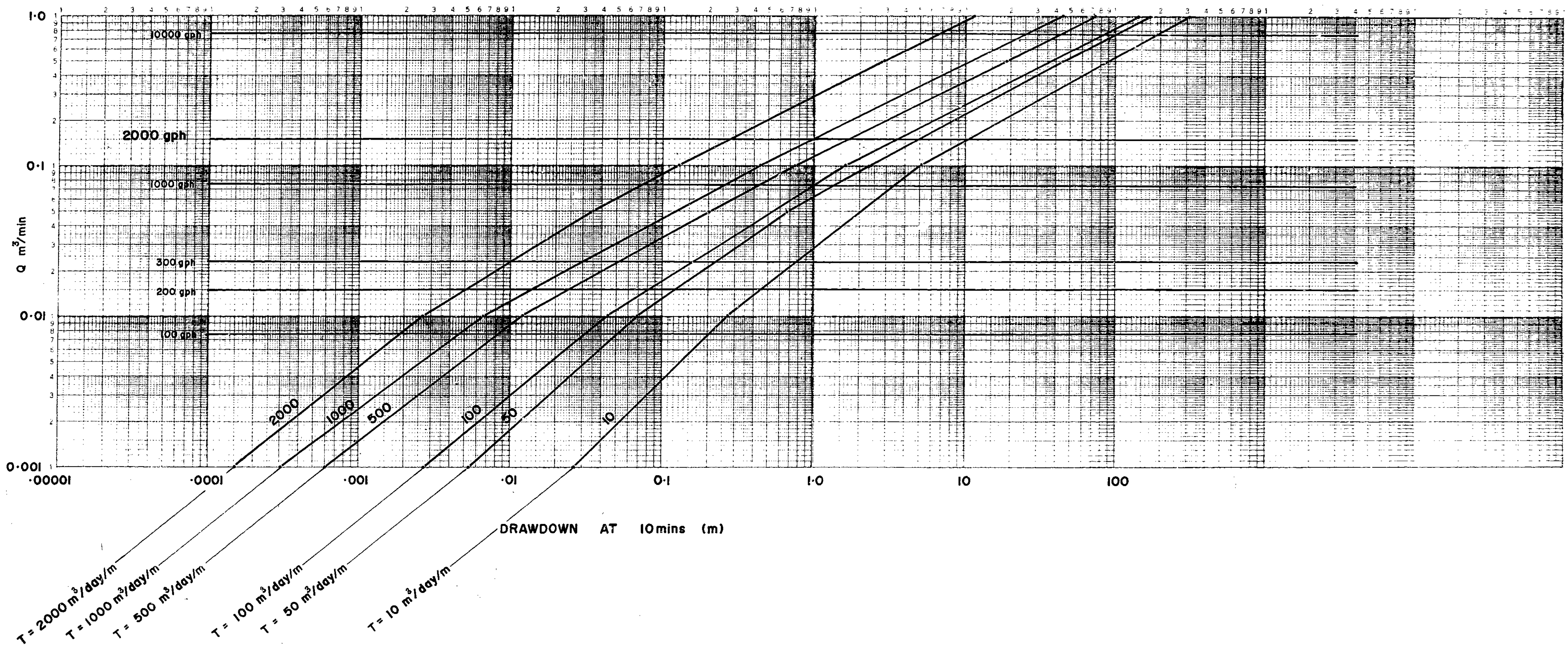


FIG. 4

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

SOUTH EAST WATER RESOURCES
MT. GAMBIER AREA INVESTIGATION
GAMBIER LIMESTONE
ESTIMATION OF TRANSMISSIVITY FROM 10min DRAWDOWN

COMPILED M. A. Cobb
DRN TE CKD
W.C.R.

SCALE —
DATE 6th FEB. 1979
PLAN NUMBER 79-124