DEPARTMENT OF MINES

SOUTH AUSTRALIA

KALANGADOO TOWN WATER SUPPLY -

WELL COMPLETION REPORT

KALANGADOO T.W.S. NO. 1 (MA 94)

FOR ENGINEERING & WATER SUPPLY DEPARTMENT

by

G.H. McNALLY

GEOLOGIST

ENGINEERING DIVISION

Rept.Bk.No. 77/80
G.S. No. 5905
D.M. No. 463/75
Eng.Div.No. NA17

CONTENTS

APPENDICES

FIGURES

DEPARTMENT OF MINES

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ABSTRACT

Kalangdoo Town Water Supply (T.W.S.) No. 1 well was drilled cable tool during February - May, 1977, and subsequently production tested. The unconfined Gambier Limestone aquifer was encountered between 5.5 and 86m, and was later cemented off down to 98m. The confined Knight Group sand aquifer was intersected between 102 and 117m, and screened 105-113m.

The results of production testing indicate that discharges of up to 1500m^3/day are permissable on draw-down considerations alone, but that screen encrustation may result from high entry velocities. A second well is being put down adjacent to Kalangadoo T.W.S. No. 1, and gravel packing or additional screen length may minimize encrustation effects. Further discharge testing, to derive more reliable transmissivity values using the new well for observation purposes, is recommended.

Water quality averages about 620 mg/l in the confined aquifer, and is marginally higher in the Gambier Limestone. Both waters are relatively hard. Though substantial leakage between the two aquifers is likely during pumping, this would not have a significant effect on water quality.

INTRODUCTION

Following a request from the Engineering and Water Supply Department, the first of two 203mm diameter production wells for the Kalangadoo Town Water Supply was commenced on 15th February, 1977 and completed on May 3rd. This well, Kalangadoo T.W.S. No. 1, is located in the northern corner of section 414, hundred of Grey, on a site in Millards Way, Kalangadoo, nominated

by the E. & W.S. Department (see Fig. 1). It was originally given the temporary number MA94.

Kalangadoo T.W.S. No. 1 will replace a large number of shallow domestic wells within the township area, and will be supplemented by a second deep well to be put down adjacent to it in the near future.

Discharge testing was carried out during April, 1977. This consisted of a 3 x 100 minute stage step-drawdown test and a 72 hour constant discharge test.

The completed hole was geophysically logged.

It should be noted that this water well is not the same as a petroleum exploration bore, Kalangadoo No. 1, put down in the area some years ago.

GEOLOGY AND HYDROGEOLOGY

The provisional stratigraphic sequence at this site is summarized below.

0 - 5.5m	sand and clay (Pleistocene - Recent)
5.5 - 86 m	Gambier limestone
86 - 90 m	Lacepede Formation
90 - 93 m	possible Compton Conglomerate equivalent
93 - 102m	Knight Group confining bed
102 - 117m	Knight Group sand aquifer

The Gambier Limestone is an unconfined aquifer, with S.W.L.'s here in the range 2 - 4m and salinities of 400 - 800 mg/l. A number of domestic wells - seldom deeper than 7m - presently draw on this aquifer. Because of the risk of shallow groundwater pollution from septic systems, the deeper confined Knight Group aquifer has been preferred for the reticulated town water supply.

DRILLING PROCEDURE

Drilling commenced 15/2/77, under permit 1004, using

Mines Department Cable Tool plant CT/17 (Driller A.H. Anderson). The drilling superintendent's completion report is included as Appendix A, and well construction details are illustrated in Fig. 7.

Sands of the Knight Group were struck at 102m, and the interval 105-113m screened. The hole was terminated at 118m.

Sludge samples were taken every 2m and at strata changes noted by the driller. Three tube samples were taken, at depths of 20, 40 and 91m; several further tube sampling attempts were unsuccessful. Water samples were taken at each cut, and every 5m. Six bulk sand samples were taken for grain size analysis at metre intervals between 108 and 114m. Results are shown in Fig. 2.

WELL DISCHARGE TESTING

Well discharge testing was carried out during the period 22-29th April, and consisted of a 3 stage step-drawdown test (at flow rates of 677, 878 and 1152 m^3/day) and a 72 hour constant discharge test (at 994 m^3/day). The pump intake depth was set at 60m, and discharge measured by means of an inline flow meter. Water levels during the tests were taken using an electric probe.

Details of test procedures are given in Appendix B. The well equation derived from these data permits a family of time - drawdown plots to be calculated for different discharge rates (Fig. 3). Since the short duration of the step drawdown test raises the possibility that discharge boundaries may be intersected during longer term pumping (i.e., the <u>actual</u> long term drawdowns may be greater than those predicted), the theoretical drawdowns were compared with those for the 72 hour test. Thus at (Q = 994 m^3/day),

t(mins)	Calculated Drawdown (m)	Actual Drawdown	Difference (m) (Calculated-Actual)
10	33.74	33.46	+0.28
100	34.63	34.42	+0.21
1000	35.53	35.73	-0.20

The excellent agreement between the two sets of values is shown graphically on Fig. 5.

It is noteworthy that the coincidence increases with duration of pumping, although predictions should not - strictly speaking - be extended beyond 10^4 minutes (about one week's continuous pumping). This point is illustrated by the fact that the difference between calculated and actual drawdown becomes negative at 1000 min (i.e. Actual drawdown is greater than calculated drawdown).

AQUIFER LEAKAGE

As a check on leakage from the unconfined aquifer, or from an underlying aquifer, drawdown vs time for Stage I and for the 72 hour test were plotted on a log - log scale, and compared with Type Curves for leaky (or semi-confined) aquifers (Fig. 6). The Knight Group sand in Kalangadoo T.W.S. No. 1 was found to be semi-confined, and a substantial proportion of discharge to be derived from above (presumably the Gambier Limestone) or below. The actual proportion could not be estimated due to the lack of an observation hole at the time of discharge testing.

Re-examination of the time/drawdown plots (Fig. 4 and 5) and of the Well Equation,

$$St = 43.7Q + 1.4Q \log_{10} t + 5.5Q^2$$

indicate that,

(i) Most of the drawdown occurs during the first minute or so of pumping (at any given discharge rate, Q). For example, during the 72 hour test drawdown after one minute was 26m, and

only 36m after 4320 minutes.

(ii) In the Well Equation this rapid initial drawdown is reflected in a high value of the well constant "a". This in turn implies a low value for Transmissivity (T) - i.e. this is a "tight" aquifer.

(iii) Transmissivity values computed from Δs in Stage I and the 72 hour test (225 and 182 $m^3/m/day$) are not, however, particularly low. The attempt to fit a log time vs log drawdown plot for both Stage I and the 72 hour test (Fig. 6) with Type Curves for leaky aquifers proved to be unreliable, owing to the absence of an observation bore and the lack of drawdowns in the first minute of pumping (needed to fit the first part of the Type Curve).

The Transmissivity obtained by Type Curve matching is given by,

$$T = \frac{Q}{4\pi s} Wu$$

and was about 3 $m^3/m/day$ - which is much too low.

The average T value of 213 $m^3/m/day$ represents the combined effects of the Knight Group sand plus leakage, while the T = 3 $m^3/m/day$ may be taken as an indication of the generally low transmissivity in the Knight sand between 102 and 117m.

(iv) The low values of Δs (and consequently of the well constant "b") for a "tight" aquifer also indicate that recharge - in the form of leakage - is taking place during pumping.

SCREEN ENTRY VELOCITIES

One important consequence of low transmissivity is a low optimum screen entry velocity. Assuming a k (permeability) value of 20m/day over an 8m screened interval, the optimum velocity (according to Walton, 1970, p. 297) is 0.01 m/sec. This corresponds to a maximum discharge rate of about 700 m^3/day for an 8m length of 5 - inch (nominal) "Surescreen" SH55 telescopic screen

(0.5mm aperture) ("Surescreen" Manual).

This is a low value for Q, in comparison with the maximum value of about 1500 m^3/day possible on drawdown considerations alone. It is likely, therefore, that this optimum entry velocity for this size and length of screen will have to be exceeded, with the attendant risk of accelerated corrosion and encrustation.

WATER QUALITY

Full AMDEL analyses and A.T.S. values for 16 water samples from the unconfined (Gambier Limestone) aquifer and for 8 samples from the confined (Knight Group) aquifer are reported in Appendix C.

These results indicate that the confined aquifer has a marginally lower salinity than the unconfined, but that the reverse is true for hardness. The Knight Group water owes its hardness to a relatively high bicarbonate content (485 - 491 mg/l). Nitrate values are 1 mg/l or less, in contrast to 21 mg/l at the upper surface of the unconfined water (which probably indicates contamination due to septic tank effluent). The low values for iron content (0.04 mg/l and less) are contrary to expectations based on preliminary field testing.

CONCLUSIONS

(1) Assuming a pump suction depth of 85m (i.e. just above the 127mm casing), an S.W.L. of 20m with a 5m seasonal variation, the working drawdown becomes 60m. From fig. 3 the maximum indefinite pumping rate - on drawdown considerations alone - would then be about 1500 m^3/day (say 15 000 g.p.h.), with up to 20 hours at 1800 m^3/day (say 18 000 g.p.h.).

(2) It is likely that the screen will have a limited life due to encrustation and/or corrosion, since screen entry velocities will almost certainly exceed the optimum value of

0.01m/sec.

(3) Transmissivity values computed from As data average about 213 m^3/m/day, but this value is probably far too high for the aquifer interval 102-117m and reflects large scale leakage from above or below.

(4) Anomalous drawdown values obtained during Stage III indicate that some development occurred at this time. As a result entry conditions improved, and drawdowns were lower than predicted. This may also be accounted for by increased leakage with time.

(5) The apparent low transmissivity may be due to the buildup of silt or fine sand round the screen. Alternatively the aquifer may be finer than indicated by the sieve analyses (Fig. 2).

(6) Leakage from the unconfined aquifer during pumping is unlikely to have any significant effect on salinity or hardness, since water quality is similar in both aquifers. A single high nitrate value in the unconfined aquifer is thought to reflect minor surface contamination only.

RECOMMENDATIONS

The principal problem with this well is that of reconciling low optimum screen entry velocities with a realistic yield - say 1 000 - 1 500 m^3/day. This might be achieved in the No. 2 (standby) well by means of the following,

(1) drilling deeper into the Knight sands, in the hope of penetrating either a higher transmissivity interval, or a greater thickness of the same T value as 102-117m. Doubling the screen length would double the safe yield, at constant T.

(2) installing a larger diameter screen in the same interval. Gravel packing a 5" screen - if practicable - could be expected to have a similar effect.

In these circumstances the No. 2 well would in fact become the production well, while Kalangadoo T.W.S. No. 1 would be relegated to the standby role.

With regard to further discharge testing it is recommended that this be carried out when the second hole is available as an observation bore. The following should be borne in mind,

(1) For good matching of log-log plots it is desirable to have drawdown readings very early in the pumping period (ideally at tenths of the first minute).

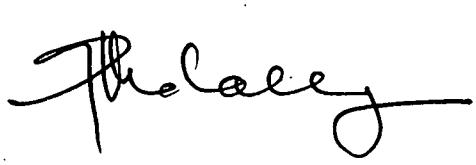
(2) A lower pumping rate, say 500 m^3/day (about 5 000 g.p.h.) or less would also permit better matching by showing the initial drawdown.

(3) Test duration need not be great - 100 minutes should be sufficient, particularly if drawdowns can be measured in the first minute.

The purpose of this additional testing would be to derive a more reliable value for T and from this - hopefully - to obtain a higher permissable screen entry velocity.

ACKNOWLEDGEMENTS

I am indebted to Tony Williams who supervised the drilling and logged the sludge samples, and to Don Armstrong for numerous constructive suggestions regarding the pump test data.



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GEOLOGIST

REFERENCES

HANCOCK, S. (-) Well Screens, their Use and Selection. Surescreen Co., Brisbane.

HAZEL, C.P. (1973) Groundwater Hydraulics. Lecture Notes for A.W.R.C. 1973 Groundwater School, Adelaide. (Irrigation and Water Supply Commission, Qld.).

JOHNSON WELL SCREEN CO. (1972) Groundwater and Wells

WALTON, W.C. (1970) Groundwater Resource Evaluation. Wiley.

APPENDIX A

DRILLING OVERSEER'S REPORT

DM 463/75

TO THE CHIEF DRILLING & MECHANICAL ENGINEER

Through the Drilling Engineer

Completion of drilling — Kalangadoo

E. & W.S. Department — TEMP. No. MA 94

T.W.S. Well (2 wells) — Permit No. 1004

A Town Water supply well was constructed on Section 414, Hundred of Grey.

The hole was drilled 254mm dia. to the top of the Knight Sands at 101m, and lined with 254mm casing to 13.50m.

203mm casing was installed and drilling continued to 108m to determine if a suitable bed of sands were present and to obtain a water sample.

The 203mm casing was then withdrawn to 98m effective length and pressure cemented to surface. 520 gallons of cement grout was used, 5 - 1 mix, comprising 68 bags of cement and 340 gallons of water. The cement plug was drilled out and 152mm casing was installed to sample the full depth of the aquifer. Layers of clay and silty sand were cut from 115m and drilling was stopped at 118m.

Eight metres of 124mm O.D. telescopic Surescreen stainless steel screen was installed from 104.90m to 113.03m, with 127mm casing from 86m to the top of the screen and from bottom of the screen to 117.80m.

A sealpiece (127mm to 203mm) was installed from 85.89m.

The screen was initially developed by bailing and surging in the 203mm casing, and completed by surging the face of the screen for 49 hours.

A 152mm test pump was installed to 60m and the bore was pumped for 14 hours to complete development and to determine flow

rates. Then 3 x 100 minute step drawdown tests were conducted, followed by a 4 320 minute continuous test and recovery.

A sketch of the bore and screen is attached.

Details of the bore are tabulated below

Commenced	15/2/77
Completed	3/5/77
Depth drilled	118m
254mm casing	0 - 13.50m. Effective length
203mm casing (pressure cemented)	0 - 98m Effective length
127mm casing	From 86m to 104.90m
124mm screen	From 104.90m to 113.03m
127mm casing	From 113.03m to 117.80m
Sealpiece 127mm to 203mm	Set from 85.89m
Water cut	5.50m - 101m
Static level	5.44m - 20.04m
Screen developed for	49 hours
Main pump test	72 hours
Average pumping rate	12 l/sec
Maximum drawdown	36.2 metres

Details of sandscreen

Type	Surescreen, S/steel
length	8.13m including couplings
O.D.	124mm
I.D.	113mm
Apertures	0.5mm

WDW/YMW

9/5/77

W.D. WILSON

DRILLING SUPERINTENDENT

APPENDIX B

DISCHARGE TESTING

72 Hour Test

Frequencies of discharge and water level readings were as follows,

0	-	10	minutes, every	1 minute.
10	-	30	minutes, every	2 minutes.
30	-	50	minutes, every	5 minutes.
50	-	100	minutes, every	10 minutes.
100	-	200	minutes, every	20 minutes.
200	-	960	minutes, every	50 minutes.
960	-	1920	minutes, every	2 hours.
1920	-	4320	minutes, every	4 hours.

Results were plotted as drawdown (in metres) vs time (in minutes, on a log scale).

Step Drawdown Test

This consisted of 3 x 100 minute stages, with no recovery between stages. Stage II and III drawdowns were recalculated to compensate for the imaginary effects of earlier pumping, according to the method of Hazel (1973).

These results were used to derive a Well Equation, the general form of which is,

$$St = aQ + bQ \log_{10} t + cQ^2$$

where, St = drawdown (m) at a given time t (mins)

Q = discharge rate (m^3/min)

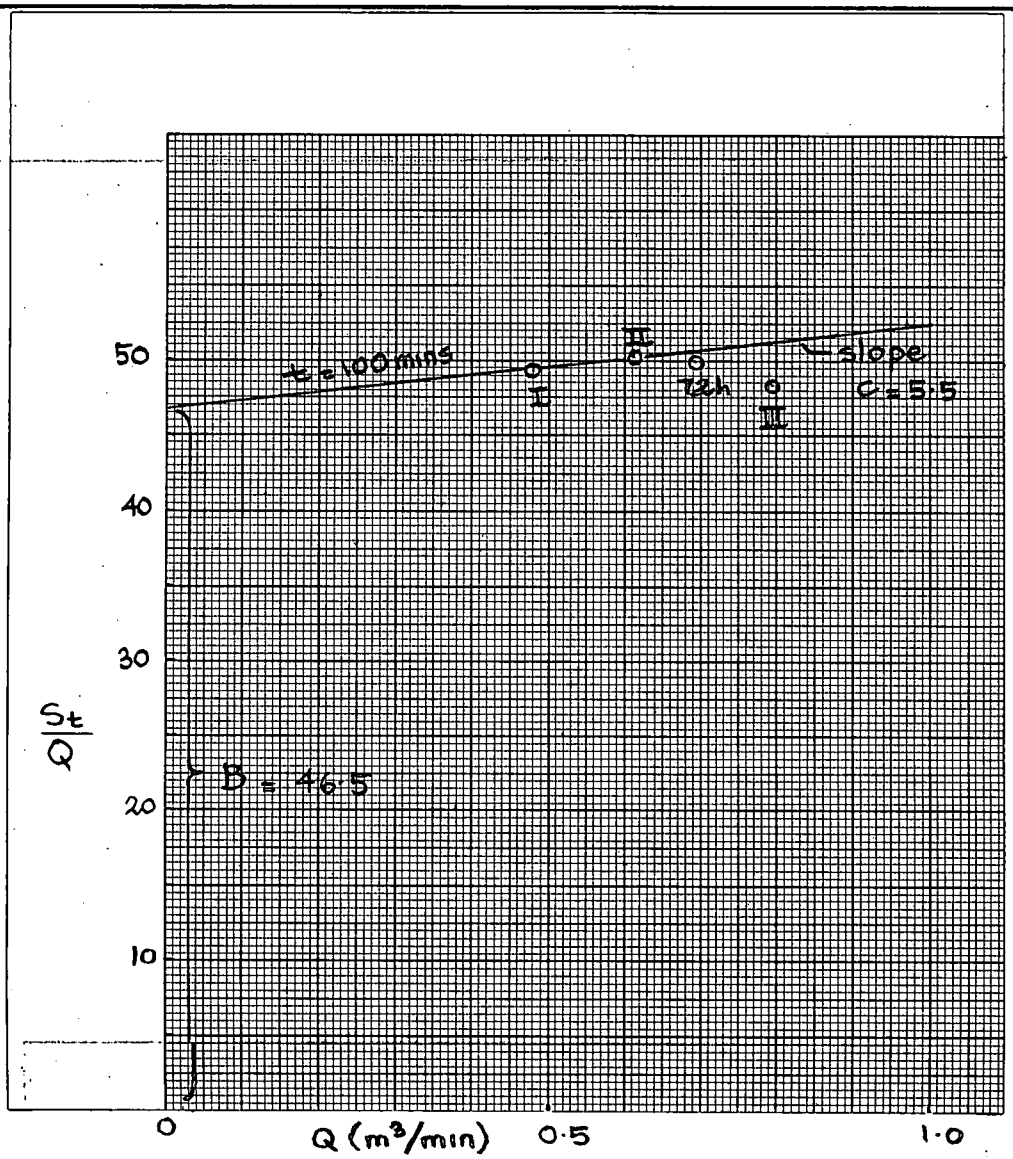
a, b = well constants related to laminar flow

and, C = well head loss due to turbulent flow

The graphical derivation of a, b and c is shown over-leaf. Values of b averaged 1.41 when anomalous values in stage III were omitted, and other parameters were (a = 43.7) and (c = 5.5) so that the equation for this particular well becomes,

$$St = 43.7Q + 1.4Q \log_{10} t + 5.5Q^2$$

Computations are outlined in the following pages. The predicted time-drawdown plots for different discharge rates are illustrated in Fig. 3.



$B = a + 2b = 46.5$

and since $b = \frac{\Delta s}{Q}$

∴ Stage I $b = \frac{0.72}{0.76} = 1.53$

II $b = \frac{0.76}{0.61} = 1.25$

III $b = \frac{0.44}{0.79} = 0.56$

72hr $b = \frac{1.00}{0.69} = 1.45$

∴ $b_{average} = 1.41$ (excluding stage III)

a	43.7
b	1.4
c	5.5

	DEPARTMENT OF MINES—SOUTH AUSTRALIA		Scale:
Compiled: GHMcN	KALANGADOO T.W.S. No.1 3 STAGE DRAWDOWN TEST COMPUTATION OF PARAMETERS		Date: 22·5·77
Drn. / Ckd.			Drg. No.

500—6.76 G6584 O

TRANSMISSIVITIES

KALANGADOO T.W.S. 1

$$T = \frac{2.3Q}{4\pi \Delta s} \quad m^3/m/min$$

∴ Stage I, $T = \frac{2.3 \times 0.47}{12.56 \times 0.72}$

$= 0.12\ m^3/m/min$

$= 173.63\ m^3/m/day$

Stage II, $T = \frac{2.3 \times 0.61}{12.56 \times 0.76}$

$= 0.15\ m^3/m/min$

$= 216.00\ m^3/m/day$

Stage III, $T = \frac{2.3 \times 0.79}{12.56 \times 0.44}$

$= 0.33\ m^3/m/min$

$= 473.45\ m^3/m/day$

72hr test, $T = \frac{2.3 \times 0.69}{12.56 \times 1.00}$

$= 0.13\ m^3/m/min$

$= 187.20\ m^3/m/day$

recovery, $\Delta s_{rec} = \Delta s = 1.00$

∴ $T_{rec} = T_{72hr} = 187.20\ m^3/m/day$

APPENDIX C

WATER QUALITY

WATER ANALYSES

Analysis No.	Depth m	Salinity (mg/l)	pH	Remarks
	SAMPLES TAKEN FROM UNCONFINED AQUIFER DURING DRILLING			
W1818/77	5.5	691	7.5	AMDEL Full Analysis
1819	5.5	660	7.3	A.T.S. From Gambier Lst (unconfined)
1820	10.0	765	7.2	A.T.S. From Gambier Lst (unconfined)
1821	15.0	710	7.2	A.T.S. From Gambier Lst (unconfined)
1822	20.0	670	7.2	A.T.S. From Gambier Lst (unconfined)
1823	25.0	675	7.2	A.T.S. From Gambier Lst (unconfined)
1824	30.0	655	7.1	A.T.S. From Gambier Lst (unconfined)
1825	35.0	625	7.1	A.T.S. From Gambier Lst (unconfined)
1826	40.0	625	7.2	A.T.S. From Gambier Lst (unconfined)
1827	45.0	630	7.2	A.T.S. From Gambier Lst (unconfined)
1828	50.0	630	7.3	A.T.S. From Gambier Lst (unconfined)
1829	55.0	630	7.2	A.T.S. From Gambier Lst (unconfined)
1830	61.0	605	7.2	A.T.S. From Gambier Lst (unconfined)
1831	66.0	605	7.1	A.T.S. From Gambier Lst (unconfined)
1832	71.0	625	7.0	A.T.S. From Gambier Lst (unconfined)
1833	76.0	615	7.0	A.T.S. From Gambier Lst (unconfined)
	SAMPLES TAKEN FROM CONFINED AQUIFER DURING DISCHARGE TESTING			
W3650/77	-	629	7.3	AMDEL. Stage I, 5 minutes
3651	-	621	7.2	AMDEL. 72 hour test, 25 minutes
3652	-	629	7.5	AMDEL. End Stage III, 300 mins.
3653	-	590	7.0	ATS. 72 hour test, 360 minutes
3654	-	590	6.9	ATS. 72 hour test, 720 minutes
3655	-	625	7.3	AMDEL. 72 hour test 24 hours
3656	-	595	7.1	ATS. 72 hour test, 48 hours
3657		630	7.3	AMDEL. 72 hour test, 72 hours

CHEMICAL COMPOSITION		MILLIGRAMS PER LITRE MG/L	MILLIEQUIVS. PER LITRE ME/L
CATIONS			
CALCIUM	(CA)	101	5.0
MAGNESIUM	(MG)	17	1.4
SODIUM	(NA)	140	6.1
POTASSIUM	(K)	3	.1
IRON	(FE)		
ANIONS			
HYDROXIDE	(OH)		
CARBONATE	(CO3)		
BICARBONATE	(HCO3)	395	6.5
SULPHATE	(SO4)	36	.8
CHLORIDE	(CL)	179	5.0
BROMIDE	(BR)		
FLUORIDE	(F)		
NITRATE	(NO3)	21	.3
PHOSPHATE	(PO4)		

TOTALS AND BALANCE

CATIONS (ME/L)	12.6	DIFF =	.0
ANIONS (ME/L)	12.6	SUM =	25.2

DIFF*100. / SUM = .0 %

DERIVED AND OTHER DATA

CONDUCTIVITY (E.C.) MICRO-S/CM AT 25 DEG. C 1275.

	MILLIGRAMS PER LITRE MG/L
TOTAL DISSOLVED SOLIDS	
A. BASED ON E.C.	
B. CALCULATED (HCO3=CO3)	691.
C. RESIDUE ON EVAP. AT 180 DEG. C	
TOTAL HARDNESS AS CACO3	322.
CARBONATE HARDNESS AS CACO3	322.
NON-CARBONATE HARDNESS AS CACO3	<1.
TOTAL ALKALINITY AS CACO3	324.
FREE CARBON DIOXIDE (CO2)	
SUSPENDED SOLIDS	
SILICA (SIO2)	
BORON (B)	

	UNITS
REACTION - PH	7.5
TURBIDITY (JACKSON)	
COLOUR (HAZEN)	
SODIUM TO TOTAL CATION RATIO (ME/L)	48.3 %

REMARKS

SAMPLE DEPTH 5.50
DEPTH TO WATER 5.5

NAME- E.W.S. DEPT
ADDRESS-KALANGADOO

HUNDRED-GRAY
SECTION-414
HOLE NO-MA 94
SUPPLY-
SAMPLE COLLECTED BY-A.H.ANDERSON

WATER CUT-
WATER LEVEL-
DEPTH HOLE-

DATE COLLECTED 17-2-77
DATE RECEIVED

WATER ANALYSIS REPORT — AMDEL COMPUTER SERVICES

SAMPLE ID. W3650/77 — JOB

CHEMICAL COMPOSITION

		MILLIGRAMS PER LITRE MG/L	MILLIEQUIVS. PER LITRE ME/L
CATIONS			
CALCIUM	(CA)	126	6.3
MAGNESIUM	(MG)	22	1.8
SODIUM	(NA)	89	3.9
POTASSIUM	(K)	5	.1
IRON	(FE)	.03	.0
ANIONS			
HYDROXIDE	(OH)		
CARBONATE	(CO3)		
BICARBONATE	(HCO3)	488	8.0
SULPHATE	(SO4)	11	.2
CHLORIDE	(CL)	135	3.8
BROMIDE	(BR)		
FLUORIDE	(F)		
NITRATE	(NO3)	1	.0
PHOSPHATE	(PO4)	.04	.0

TOTALS AND BALANCE

CATIONS (ME/L)	12.1	DIFF =	.0
ANIONS (ME/L)	12.1	SUM =	24.2

$$\frac{\text{DIFF} * 100.}{\text{SUM}} = .2\ \%$$

DERIVED AND OTHER DATA

CONDUCTIVITY (E.C.)
MICRO-S/CM AT 25 DEG. C 1110.

	MILLIGRAMS PER LITRE MG/L
TOTAL DISSOLVED SOLIDS	
A. BASED ON E.C.	
B. CALCULATED (HCO3=CO3)	629.
C. RESIDUE ON EVAP. AT 180 DEG. C	
TOTAL HARDNESS AS CACO3	405.
CARBONATE HARDNESS AS CACO3	400.
NON-CARBONATE HARDNESS AS CACO3	5.
TOTAL ALKALINITY AS CACO3	400.
FREE CARBON DIOXIDE (CO2)	
SUSPENDED SOLIDS	
SILICA (SIO2)	
BORON (B)	

	UNITS
REACTION - PH	7.3
TURBIDITY (JACKSON)	
COLOUR (HAZEN)	
SODIUM TO TOTAL CATION RATIO (ME/L)	32.0 %

REMA

NAME- E.W.S. DEPT
ADDRESS-

DATE COLLECTED 22-4-77
DATE RECEIVED

HUNDRED-GREY
SECTION-414
HOLE NO-MA 94
SUPPLY-
SAMPLE COLLECTED BY-A.H.ANDERSON

WATER CUT- PUMPED
WATER LEVEL-
DEPTH HOLE-

WATE ANALY REP T AMDEL COMP TER RVI

SAMPLE ID. W3651/77 JOB

CHEMICAL COMPOSITION

		MILLIGRAMS PER LITRE MG/L	MILLIEQUIVS. PER LITRE ME/L
CATIONS			
CALCIUM	(CA)	126	6.3
MAGNESIUM	(MG)	22	1.8
SODIUM	(NA)	87	3.8
POTASSIUM	(K)	3	.1
IRON	(FE)	.03	.0
ANIONS			
HYDROXIDE	(OH)		
CARBONATE	(CO3)		
BICARBONATE	(HCO3)	485	7.9
SULPHATE	(SO4)	11	.2
CHLORIDE	(CL)	133	3.8
BROMIDE	(BR)		
FLUORIDE	(F)		
NITRATE	(NO3)	<1	.0
PHOSPHATE	(PO4)	.03	.0

TOTALS AND BALANCE

CATIONS (ME/L)	12.0	DIFF =	.0
ANIONS (ME/L)	11.9	SUM =	23.9

DIFF*100. / SUM = .1 %

DERIVED AND OTHER DATA

CONDUCTIVITY (E.C.)
MICRO-S/CM AT 25 DEG. C 1114.

	MILLIGRAMS PER LITRE MG/L
TOTAL DISSOLVED SOLIDS	
A. BASED ON E.C.	
B. CALCULATED (HCO3=CO3)	621.
C. RESIDUE ON EVAP. AT 180 DEG. C	
TOTAL HARDNESS AS CACO3	405.
CARBONATE HARDNESS AS CACO3	398.
NON-CARBONATE HARDNESS AS CACO3	8.
TOTAL ALKALINITY AS CACO3	398.
FREE CARBON DIOXIDE (CO2)	
SUSPENDED SOLIDS	
SILICA (SIO2)	
BORON (B)	

	UNITS
REACTION - PH	7.2
TURBIDITY (JACKSON)	
COLOUR (HAZEN)	
SODIUM TO TOTAL CATION RATIO (ME/L)	31.6 %

REMARK

NAME- E.W.S.
ADDRESS-

DATE COLLECTED 26-4-77
DATE RECEIVED

HUNDRED-GREY
SECTION-414
HOLE NO-MA 94
SUPPLY-
SAMPLE COLLECTED BY-A.H.ANDERSON

WATER CUT- PUMPED
WATER LEVEL-
DEPTH HOLE-

[redacted] WATER ANALYSIS DEPT [redacted] AMD [redacted] CO [redacted] TER [redacted] ERVICES

SAMPLE ID. W3652/77

JOB

REMARK

CHEMICAL COMPOSITION

		MILLIGRAMS PER LITRE MG/L	MILLIEQUIVS. PER LITRE ME/L
CATIONS			
CALCIUM	(CA)	127	6.3
MAGNESIUM	(MG)	22	1.8
SODIUM	(NA)	89	3.9
POTASSIUM	(K)	3	.1
IRON	(FE)	.03	.0
ANIONS			
HYDROXIDE	(OH)		
CARBONATE	(CO3)		
BICARBONATE	(HCO3)	488	8.0
SULPHATE	(SO4)	12	.2
CHLORIDE	(CL)	136	3.8
BROMIDE	(BR)		
FLUORIDE	(F)		
NITRATE	(NO3)	<1	.0
PHOSPHATE	(PO4)	.03	.0

TOTALS AND BALANCE

CATIONS (ME/L)	12.1	DIFF =	.0
ANIONS (ME/L)	12.1	SUM =	24.2

DIFF*100. / SUM = .1 %

DERIVED AND OTHER DATA

CONDUCTIVITY (E.C.)
MICRO-S/CM AT 25 DEG. C 1116.

TOTAL DISSOLVED SOLIDS	MILLIGRAMS PER LITRE MG/L
A. BASED ON E.C.	
B. CALCULATED (HCO3=CO3)	629.
C. RESIDUE ON EVAP. AT 180 DEG. C	

TOTAL HARDNESS AS CACO3	408.
CARBONATE HARDNESS AS CACO3	400.
NON-CARBONATE HARDNESS AS CACO3	8.
TOTAL ALKALINITY AS CACO3	400.
FREE CARBON DIOXIDE (CO2)	
SUSPENDED SOLIDS	
SILICA (SIO2)	
BORON (B)	

	UNITS
REACTION - PH	7.5
TURBIDITY (JACKSON)	
COLOUR (HAZEN)	
SODIUM TO TOTAL CATION RATIO (ME/L)	32.0 %

NAME- E.W.S. DEPT
ADDRESS-

DATE COLLECTED 22-4-77
DATE RECEIVED

HUNDRED-GREY
SECTION-414
HOLE NO-MA 94
SUPPLY-
SAMPLE COLLECTED BY-A.H.ANDERSON

WATER CUT- PUMPED
WATER LEVEL-
DEPTH HOLE-

[redacted] WA[redacted]R A[redacted]YSI[redacted]EP[redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] [redacted] AMDEL COMPUTER SERVICES

SAMPLE ID. W3655/77

JOB

REMARK

CHEMICAL COMPOSITION

		MILLIGRAMS PER LITRE MG/L	MILLIEQUIVS. PER LITRE ME/L
CATIONS			
CALCIUM	(CA)	126	6.3
MAGNESIUM	(MG)	22	1.8
SODIUM	(NA)	87	3.8
POTASSIUM	(K)	3	.1
IRON	(FE)	.04	.0
ANIONS			
HYDROXIDE	(OH)		
CARBONATE	(CO3)		
BICARBONATE	(HCO3)	488	8.0
SULPHATE	(SO4)	12	.2
CHLORIDE	(CL)	135	3.8
BROMIDE	(BR)		
FLUORIDE	(F)		
NITRATE	(NO3)	<1	.0
PHOSPHATE	(PO4)	.02	.0

TOTALS AND BALANCE

CATIONS (ME/L)	12.0	DIFF =	.1
ANIONS (ME/L)	12.1	SUM =	24.0

DIFF*100. / SUM = .4 %

DERIVED AND OTHER DATA

CONDUCTIVITY (E.C.)
MICRO-S/CM AT 25 DEG. C 1114.

	MILLIGRAMS PER LITRE MG/L
TOTAL DISSOLVED SOLIDS	
A. BASED ON E.C.	
B. CALCULATED (HCO3=CO3)	625.
C. RESIDUE ON EVAP. AT 180 DEG. C	
TOTAL HARDNESS AS CACO3	405.
CARBONATE HARDNESS AS CACO3	400.
NON-CARBONATE HARDNESS AS CACO3	5.
TOTAL ALKALINITY AS CACO3	400.
FREE CARBON DIOXIDE (CO2)	
SUSPENDED SOLIDS	
SILICA (SIO2)	
BORON (B)	

	UNITS
REACTION - PH	7.3
TURBIDITY (JACKSON)	
COLOUR (HAZEN)	
SODIUM TO TOTAL CATION RATIO (ME/L)	31.6 %

NAME- E.W.S. DEPT
ADDRESS-

DATE COLLECTED 27-4-77
DATE RECEIVED

HUNDRED-GREY
SECTION-414
HOLE NO-MA 94
SUPPLY-
SAMPLE COLLECTED BY-P.BARTOSEK

WATER CUT- PUMPED
WATER LEVEL-
DEPTH HOLE-

[redacted] WATER ANALYSIS REPORT [redacted] MD [redacted] CONSULTER [redacted] RVICES

SAMPLE ID. W3657/77 JOB

CHEMICAL COMPOSITION		MILLIGRAMS PER LITRE MG/L	MILLIEQUIVS. PER LITRE ME/L
CATIONS			
CALCIUM	(CA)	126	6.3
MAGNESIUM	(MG)	22	1.8
SODIUM	(NA)	89	3.9
POTASSIUM	(K)	3	.1
IRON	(FE)	.03	.0
ANIONS			
HYDROXIDE	(OH)		
CARBONATE	(CO3)		
BICARBONATE	(HCO3)	491	8.0
SULPHATE	(SO4)	13	.3
CHLORIDE	(CL)	135	3.8
BROMIDE	(BR)		
FLUORIDE	(F)		
NITRATE	(NO3)	<1	.0
PHOSPHATE	(PO4)	.02	.0

TOTALS AND BALANCE

CATIONS (ME/L)	12.0	DIFF =	.1
ANIONS (ME/L)	12.1	SUM =	24.2

$\frac{\text{DIFF}*100.}{\text{SUM}} = .4\ \%$

DERIVED AND OTHER DATA	MILLIGRAMS PER LITRE MG/L	UNITS
CONDUCTIVITY (E.C.) MICRO-S/CM AT 25 DEG. C 1110.		
TOTAL DISSOLVED SOLIDS		
A. BASED ON E.C.		
B. CALCULATED (HCO3=CO3)	630.	
C. RESIDUE ON EVAP. AT 180 DEG. C		
TOTAL HARDNESS AS CACO3	405.	
CARBONATE HARDNESS AS CACO3	402.	
NON-CARBONATE HARDNESS AS CACO3	3.	
TOTAL ALKALINITY AS CACO3	402.	
FREE CARBON DIOXIDE (CO2)		
SUSPENDED SOLIDS		
SILICA (SIO2)		
BORON (B)		
REACTION - PH	7.3	
TURBIDITY (JACKSON)		
COLOUR (HAZEN)		
SODIUM TO TOTAL CATION RATIO (ME/L)	32.1 %	

REMARK

NAME- E.W.S. DEPT
ADDRESS-

DATE COLLECTED 29-4-77
DATE RECEIVED

HUNDRED-GREY
SECTION-414
HOLE NO-MA 94
SUPPLY-
SAMPLE COLLECTED BY-A.H.ANDERSON

WATER CUT- PUMPED
WATER LEVEL-
DEPTH HOLE-

APPENDIX D

BORE LOG

PROJECT: KALANGADOO TOWN WATER SUPPLY

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

BORE LOG

HOLE NO. MA 94
UNIT/STATE NO: 7022994WW00690
SERIAL NO:
FOLDER NO.

LOCATION OR CO-ORDS:

SEC. 414 HD. Grey

EL Surface
EL ref. point
Datum

DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	SUPPLY *m³/day	SUPPLY Method of test	TOTAL DISSOLVED SOLIDS milligrammes/litre	TOTAL DISSOLVED SOLIDS Analysis W. NO.

HOLE Dia. DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from	DEPTH (m) to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
0			0	0.8	Topsoil- sand, 95% very fine to fine grained quartz, some to 1mm - subangular and clear to red brown stained. Minor silt, organic material, slightly calcareous. Brown.		Quaternary			
0.5										
0.6										
0.8			0.8	5.5	Clay, very sandy with 25-40% quartz as above. Some subrounded pebbles of non magnetic ferruginous matter (to 10mm). Calcareous, sticky and greyish yellow.					
1					1.0-3.0m as above, abundant silt size to very fine quartz. Minor Fe grains, buff colour.					
3					3.0-5.5m as above, stained quartz as above. Some fragments of buff quartzose, moderately well cemented limestone. Colour overall - buff to orange brown.					
5										
			5.5	12	Limestone, 30-40% v. fine subangular to coarse (2mm) subrounded clear grains. Rest carbonate grains, shell fragments to 6mm, Fe grains, bryozoa, forams. Yellow brown soft to hard pods. Fossils to 15mm. Silt <5%					
6										

NOTE VARIABLE SCALE 0-6m

*NOTE: 1000 gals./hr. = 110 m³/day

REMARKS

DRILL TYPE C.T. | LOGGED BY: A.F.W.
CIRCULATION: | DATE:
START: 15.2.77 | TRACED BY:
FINISH: 3.5.77 | DATE:
SHEET 1 OF 6

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

PROJECT: KALANGADOO TOWN WATER SUPPLY

BORE LOG

CONTINUATION SHEET

HOLE NO MA 94

UNIT/STATE NO:

HOLE Dia. / DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from	DEPTH (m) to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
6					6-8m as above, subrounded quartz to 3mm and coarser, better cemented.					
					8-10m as above, some paler material, recrystallized calcite (shell fragments). Quartz 15-20%					
10					10-12m as above, 10-15%					
			12	58	Limestone, bryozoal, fine to coarse grained, mostly bryozoa - some to 4mm. Forams, silty 20-25% off white - few yellowish grains weakly cemented. Typical bryozoal calcarenite phase of Gambier Limestone	Gambier Limestone				
					14.0-16.0m as above, some larger bryozoa 1-4mm.					
15					16-20m as above, some partially silicified					
20					20-26m as above, (shoe sample) - slightly marly, some orange yellow brown staining.					
25					26-28m as above, slightly greyer.					
					28-30m as above but 15-20% marl, sticky and pale grey					
30					30-32m as above but 5% marl, 20-25% silt					

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

PROJECT: KALANGADOO TOWN WATER SUPPLY

BORE LOG

CONTINUATION SHEET

HOLE NO. MA 94

UNIT/STATE NO:

HOLE Dia. DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
31					32-34m as above, but 10% marl. Some partly silicified limestone as in 16-18m interval. Greyish cream					
					34-36m as above 15-20% silt Note - 28 - 36m poor aquifer					
35					36-38m as above mut no marl, 15-20% silt, grey flint, large bryozoa 2mm x 6mm. Shell fragments					
					38-40m as above, but 5% marl					
40					40-44m as above but 7% marl					
					44-48m as above for 12-26m - 20-25% coarse silt.					
45										
					48-52m as above, large flint fragments, slightly greyer.					
50										
					52-56m as above, slightly more silty and 1%-2% marl.					
56										

Gambier Limestone

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

PROJECT: KALANGADOO TOWN WATER SUPPLY

BORE LOG

CONTINUATION SHEET

HOLE NO. MA 94

UNIT/STATE NO:

HOLE Dia. DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
56					56-58m as above, silt 30-35%					
			58	61	Marly limestone, pale grey, very sticky, weakly cemented, 30-40% marl and silt.					
60					60-61m as above, 25-30% marl, silt.					
			61	72	Limestone as for 12-26m. <2% marl but overall creamy grey.					
					64-68m as above, some coarse bryozoal fragments and some fragments of hard fine grained limestone					
65										
					68-70m as above, abundant flint					
70					70-72m as above, silt 30-35%					
			72	86	Marly limestone as for 58-61m but 20-30% marl and silt	Gambier Limestone				
75										
80										

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

PROJECT: KALANGADOO TOWN WATER SUPPLY

BORE LOG

CONTINUATION SHEET

HOLE NO. MA 94

UNIT/STATE NO:

HOLE Dia. DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
81					82-84m - as above, greenish tinge fine grains of dark green glauconite. Some more marly zones.					
					84-86m as above, more glauconite but still less than 1%. Some very hard - silicified?	Gambier Lst.				
85										
			86	90	Marl, sticky, greenish grey with brownish tinge, fine glauconite. Some limestone fragments - harder.					
					88-90m as above, abundant fine glauconite, 1%	Lacepede Fm.				
90			90	93	Sand, silty and clayey 15-20%, rest quartz, clear to brown (Fe?) stained grains mainly fine and subangular. Some carbonate and bryozoa (10% possible from above). 1% dark green glauconite. Occasional foram. Colour buff. Weakly cemented. Possibly Compton Conglomerate equivalent					
					92-93m as above	Compton Cgl.?				
93			93	102	Clay, dark brown, abundant fine quartz, some to 2mm and well rounded. Total quartz 30-40%. Sticky moderately well cemented. HT CORE 60					
94					94-100m as above, some dark grains. Laminated					
95						Knight Group				
98										

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

PROJECT: KALANGADOO TOWN WATER SUPPLY

BORE LOG

CONTINUATION SHEET

HOLE NO. MA 94

UNIT/STATE NO:

HOLE Dia. DEPTH m	CORE	GRAPHIC LOG	DEPTH (m) from	to	GEOLOGICAL DESCRIPTION OF SAMPLE	UNIT	AGE	CASING	WATERS CUT	WATER LEVEL
100					100-102m as above, some pockets of fine sand, little clay.					
102			102	117	Sand, 15-20% silt, minor clay, rest fine to coarse subangular to occasionally rounded quartz, clear with a few milky grains. Some pyrite; loose to weakly cemented.					
103					103-104m as above, micaceous and silt <5%. Uncemented.					
104					104-105m as above, some grains to 4mm.					
105					105-108m as above, very clean					
108					108-109m, as above, slightly finer, 1% silt and some dark grains.					
109					109-112m as above					
112					112-113m as above, gritty with grains to 8mm. Some ? carbonaceous material.					
					113-114 as above ? carbonaceous fragments to 10mm.					
114					114-115m as above, 5-10% silt.					
					115-116m as above, mainly fine grained, silty & clayey. 15-20%. Some white to yellow calcareous material - contaminant?					
116					116-117m as above, probably passing into finer silt sequence. Non calcareous.					
			117	118	Silt, very fine quartz, mica, pyrite etc. Slightly sticky - weakly cemented.					
118					END OF HOLE - 118m					

Knight Group

SHEET 6 OF 6

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

PROJECT:

CORE DESCRIPTION

HOLE NO MA94
UNIT/STATE NO:
7022994WW00690

CORE Dia.	DEPTH m	GRAPHIC LOG	GEOLOGICAL DESCRIPTION OF CORE (or bit sample if stated)

20-20.4 Tube Sample
Top - Limestone - bryozoal 95% fine to coarse, some fragments to 8 mm moderately well cemented, off white, forams.
Bottom - as above. Typical bryozoal phase of Gambier Lst.

40-40.4 Tube Sample .
Top - Limestone, silty 10-15%, 30-40% bryozoal fragments to 3 mm, rest carbonate grains and matrix. Core soft, friable, greyish white. Some olive glauconite. Forams abundant.
Bottom - as above.

Bit sample - Limestone, pale brownish gray and pale grey, marly - similar to above (see sludge sample log).

Bit sample - Marl, sticky, greenish grey, some fine glauconite, some limestone fragments (see log).

Fragments from bailer - different rock types including flint (greenish grey), grey moderately cemented limestone, some very well cemented hard fine grained calcarenite with olive glauconite.

Bit sample - Marl, banded very light brown and brownish grey, abundant dark green glauconite, lumps of hard white to cream limestone.

Bit sample, as above, 88 m, greenish and abundant very fine glauconite.

91-91.4 Tube Sample.
Top - Limestone-sand, 40-50% carbonate grains, bryozoal fragments and forams to 1-2 mm - all white. 1% brown glauconite pellets, rest yellow to brown stained subangular quartz, mainly fine to medium grained. Soft with well cemented pods. Core friable. Overall colour yellow brown.
Bottom - as above, mostly sand, some shell fragments about 10 mm, some greenish glauconite. Hard pebbles of limestone to 20 mm.

Bit sample - clay, very dark grey to dark brown, delicate pinkish brown fossil fragments, richly pyritic in part, 15-35% quartz, all fine but some larger grains to 3-4 mm.

Bit Sample - as for 94 m.

Bit sample - as for 94 m, but light to dark brown and grey laminations. Large quartz grains to 4 mm - sub to well rounded

DEPARTMENT OF MINES — SOUTH AUSTRALIA
ENGINEERING DIVISION

PROJECT:

CORE DESCRIPTION

HOLE NO MA94
UNIT/STATE NO:

CORE Dia.	DEPTH m	GRAPHIC LOG	GEOLOGICAL DESCRIPTION OF CORE

Bit sample - clay as for 94 m, grey and brown, light and dark, quartz pebbles, pyritic nodules to 10-20 mm.

Bit sample, as above.

Bit sample, as above.

Bit sample, as above.

FIGURES

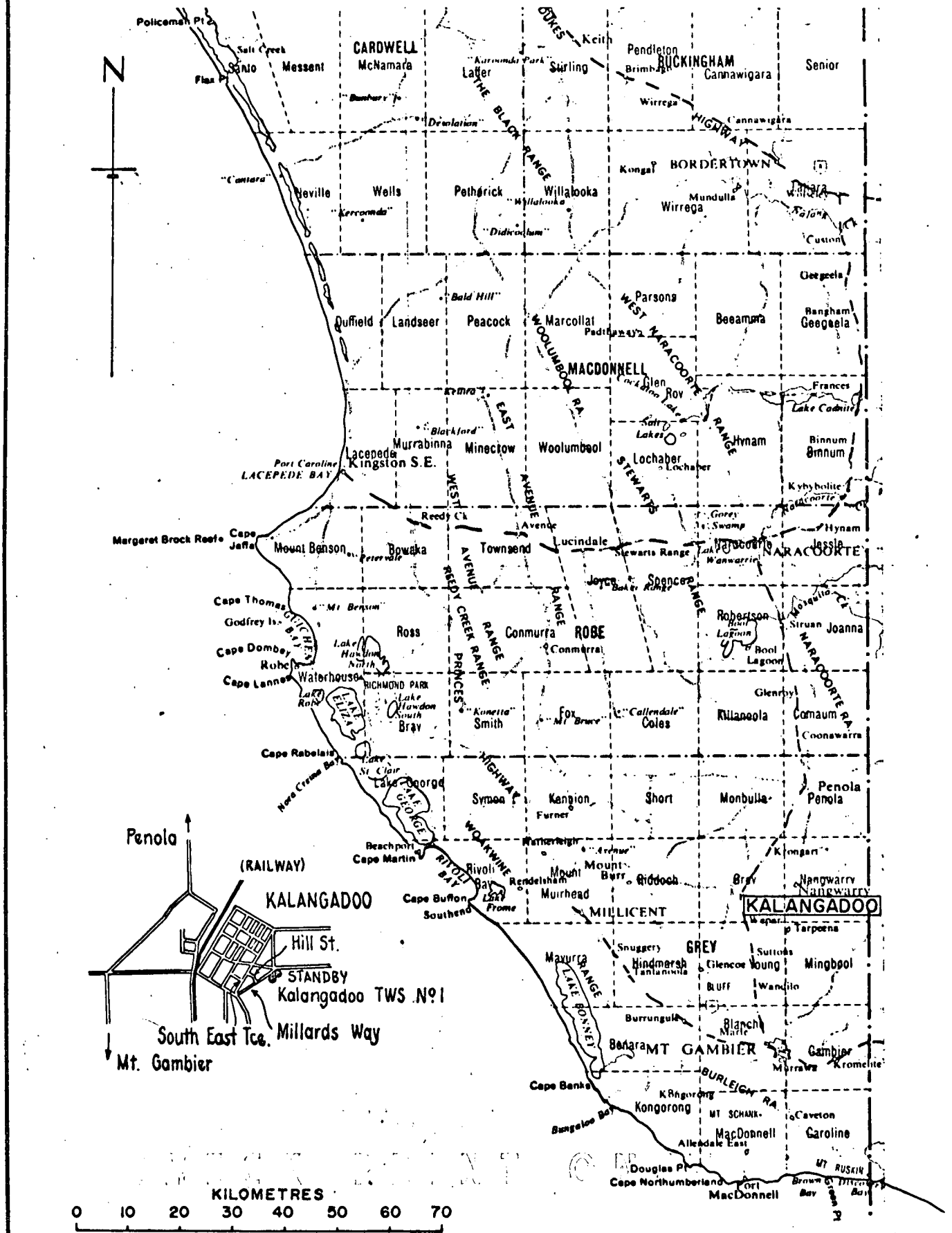
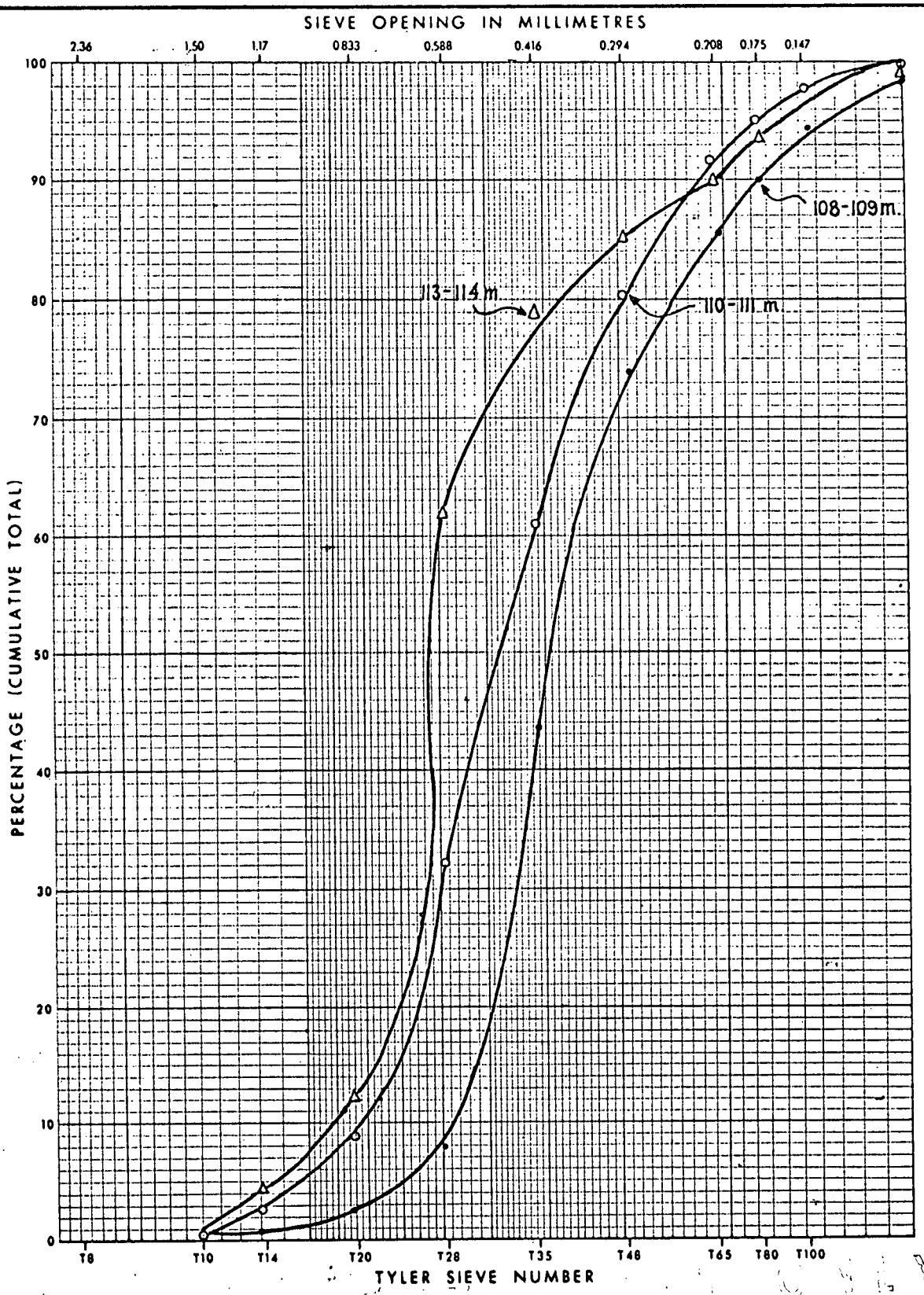


FIG. 1

	DEPARTMENT OF MINES—SOUTH AUSTRALIA	Scale: 1:1,000,000
Compiled: G.H. McN	KALANGADOO TOWN WATER SUPPLY NO. 1 (MA 94)	Date: 30·6·77
Drn. T.E. Ckd.		Drg. No. S 12756
	LOCALITY PLAN	

7022-IV



INTERVAL.....m TO.....m

BOREHOLE STATE No.....

SCREEN RECOMMENDED.....

BOREHOLE IDENTIFYING No.....

FIG. 2

HYDROGEOLOGY SECTION	DEPARTMENT OF MINES - SOUTH AUSTRALIA	DM.
Compiled: G. H. McN	SCREEN SIZE ANALYSIS	Date: 24·5·77
Drn: T. E.	KALANGADOO TOWN WATER SUPPLY NO. 1 (MA 94)	Drg.No: S 12757
Ckd:		

P.F. No. 6255 MH

7022-IV

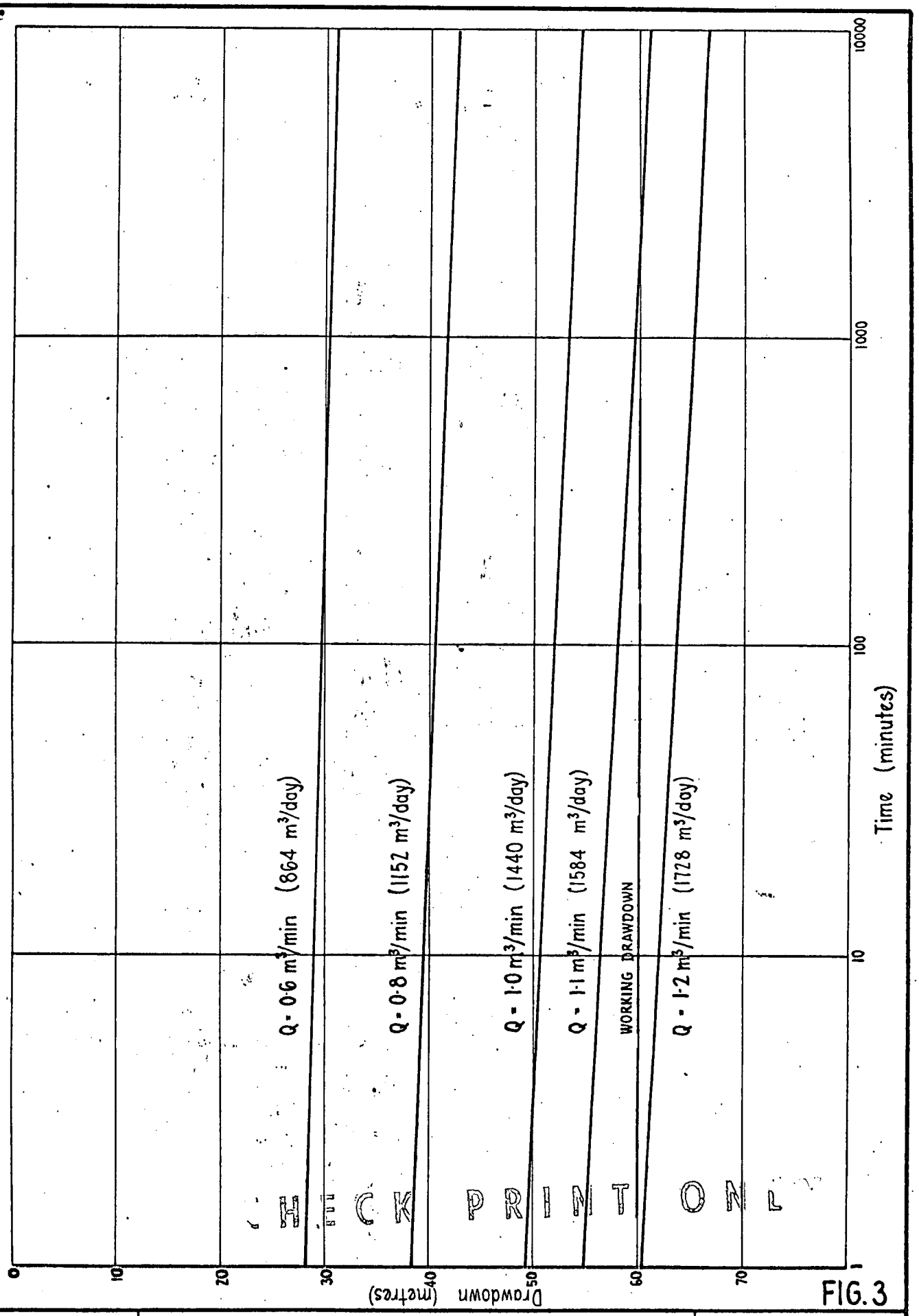
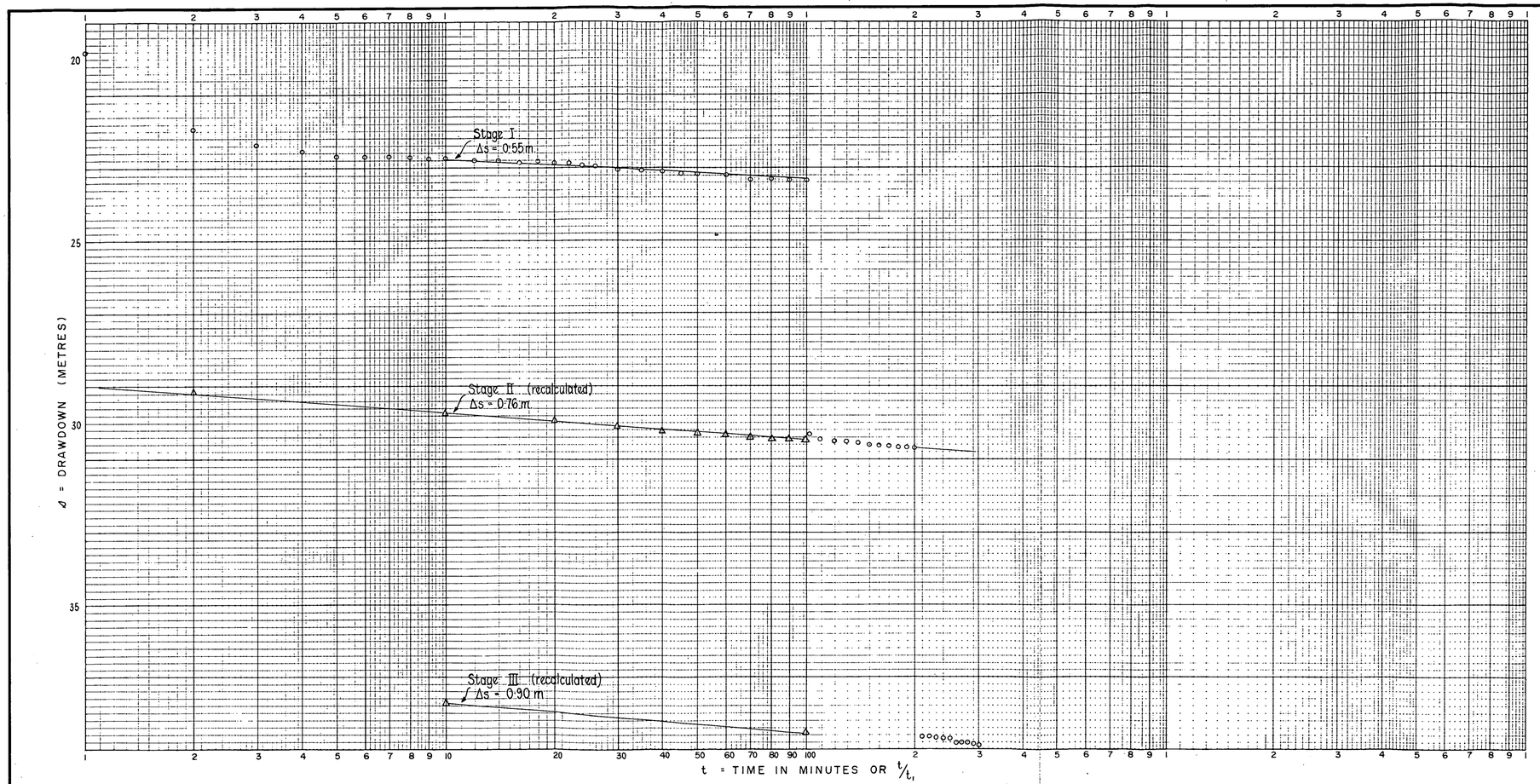


FIG. 3

	DEPARTMENT OF MINES — SOUTH AUSTRALIA	Scale : —
Compiled : G.H. McN	KALANGADOO TOWN WATER SUPPLY NO. 1 (MA 94)	Date : 30·6·77
Drn. T.E. | Ckd	THEORETICAL DRAWDOWN VS. TIME	Drg. No. S 12758



BOREHOLE STATE/UNIT No. 7022 994 WW 00690
REF. PT. ..... (m) above ground
AQUIFER FROM 102 TO 117 (m)
HOLE DEPTH 118 (m)

TYPE OF PUMP .....
LENGTH OF TEST .....
DEPTH WATER LEVEL AT TEST START (ℓ_2) 20·45 (m)
DEPTH PUMP INTAKE (ℓ_1) 60 (m)
* AVAILABLE DRAWDOWN ..... (m)

EQUATIONS

$$T = \frac{0{\cdot}183 \times Q}{\Delta_\delta} \qquad S = \frac{2{\cdot}25 \times T t_o}{r^2}$$

In which

T = Transmissivity (m^3/day/m)
Q = Pumping Rate (m^3/day)
Δ_δ = Drawdown per log cycle (m)
S = Storage Coefficient
t_o = Zero drawdown time (mins)
r = Distance to Observation Bore (m)
1 day = $8{\cdot}64 \times 10^4$ secs.

DATA

	Q m^3/day	Δ_δ (m)	T (m^3/m/day)
Stage I	0·47	0·55	225
II	0·61	0·76	211
III	0·80	0·90	234

o measured drawdown

Δ recalculated drawdowns (for Stages II and III)

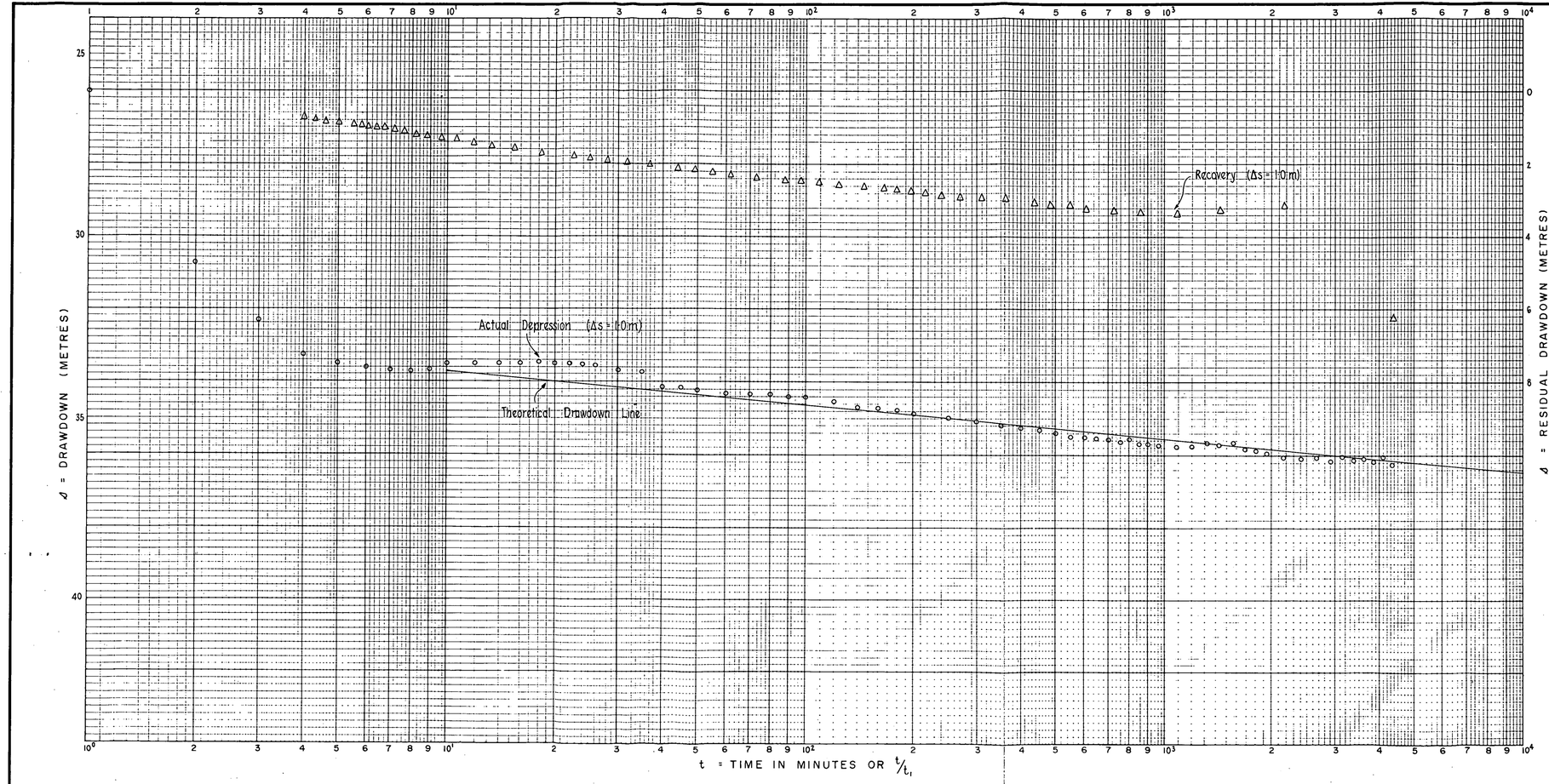
* Available drawdown = $\ell_1 - \ell_2$

FIG. 4

ENGINEERING DIVISION	DEPARTMENT OF MINES – SOUTH AUSTRALIA	D.M.
COMPILED G. H. McN	KALANGADOO TOWN WATER SUPPLY NO. 1 (MA 94)	DATE 19·5·77
DRN T.E. CKD	3 STAGE DRAWDOWN TEST	PLAN NUMBER 77-585

P.F. No. 69–953 MH

7021-IV



BOREHOLE STATE/UNIT No. 7022-994-WW.00690.
REF. PT. ..... (m) above ground
AQUIFER FROM 102 TO 117 (m)
HOLE DEPTH 118 (m)

TYPE OF PUMP .....
LENGTH OF TEST .....
DEPTH WATER LEVEL AT TEST START (ℓ_2) 20·41 (m)
DEPTH PUMP INTAKE (ℓ_1) 60 (m)
* AVAILABLE DRAWDOWN ..... (m)

EQUATIONS

$$T = \frac{0.183 \times Q}{\Delta_s} \qquad S = \frac{2.25 \times T t_o}{r^2}$$

In which

T = Transmissivity (m^3/day/m)
Q = Pumping Rate (m^3/day)
Δ_s = Drawdown per log cycle (m)
S = Storage Coefficient
t_o = Zero drawdown time (mins)
r = Distance to Observation Bore (m)
1 day = 8.64×10^4 secs.

DATA

Q (m^3/day)	Δ_s (m)	t_o	r
994	1·0	~	

CALCULATIONS

$$T = \frac{0.183 \times 994}{1} = 182 \text{ m}^3\text{/m/day (drawdown and recovery)}$$

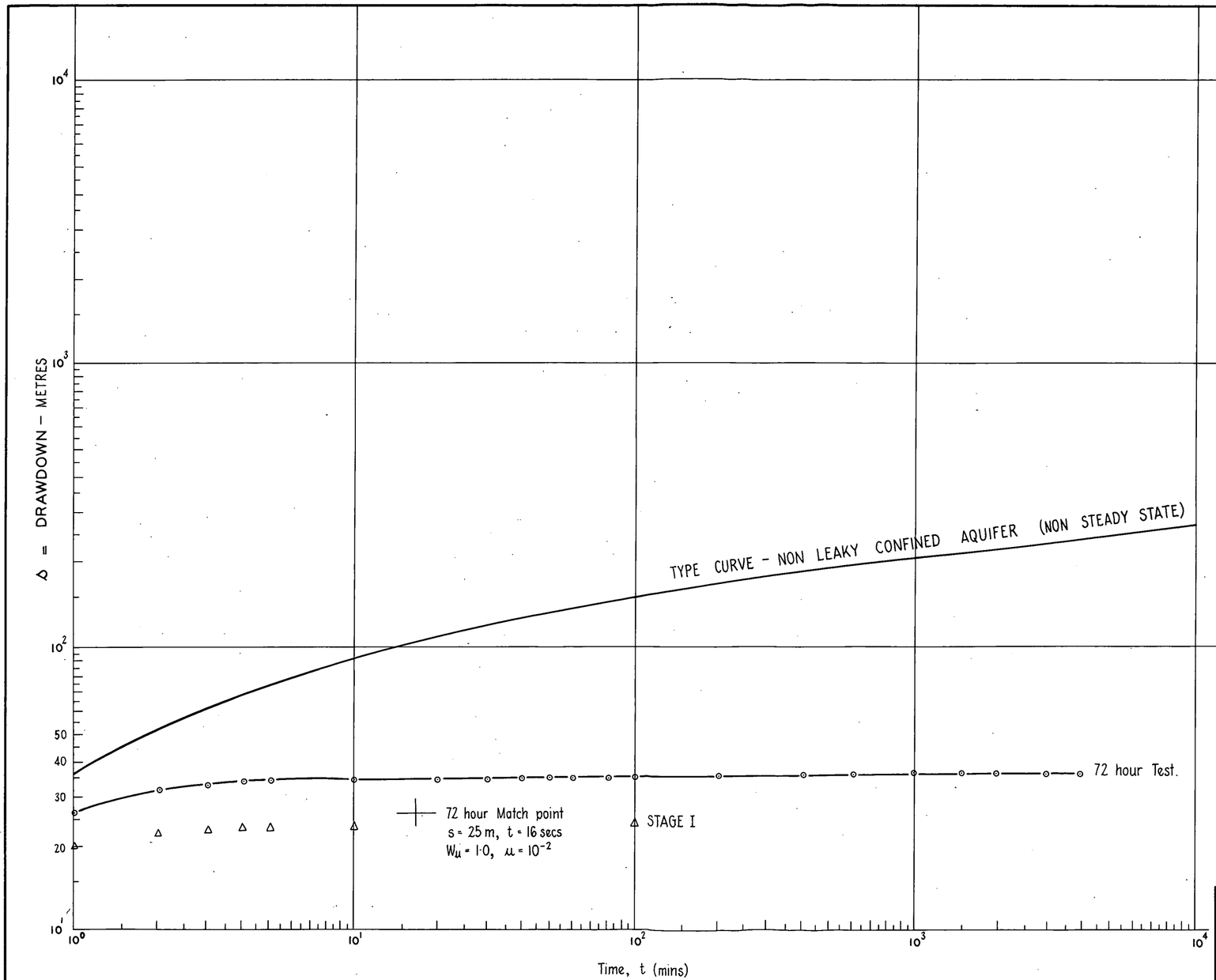
* Available drawdown = $\ell_1 - \ell_2$

FIG. 5

ENGINEERING DIVISION	DEPARTMENT OF MINES – SOUTH AUSTRALIA	D.M.
COMPILED G. H. McN	KALANGADOO TOWN WATER SUPPLY NO. 1 (MA 94)	DATE 30·6·77
DRN T.E. CKD	72 HOUR DRAWDOWN & 24 HOUR RECOVERY CURVES	PLAN NUMBER 77-586

P.F. No. 69–953 MH

7022-IV



BOREHOLE STATE Nº 7022-994 WW 00690
DEPTH TO WATER LEVEL
AT TEST START (L)*
PUMP INTAKE DEPTH (L)
AVAILABLE DRAWDOWN (L)
TYPE OF PUMP
DISCHARGE STARTED AT ON
DISCHARGE STOPPED AT ON
AQUIFER FROM TO (L)
HOLE DEPTH (L)

AT MATCHPOINT

Q = 994 m³/day
r =
Δ = 25 m
t = 16/1440 days
W(u) = 1
u = 10^{-2}

CALCULATIONS

DRAWDOWN:–

$$T = \frac{Q}{4\pi\Delta} W(u) = \frac{994}{4\pi \times 25}$$

$$= 3{\cdot}17\ m^3/m/day$$

$$S = \frac{4\,Tut}{r^2} = 4x$$

$$=$$

RECOVERY:–

$$T = \frac{Q}{4\pi\Delta} W(u) = \quad$$

$$=$$

$$S = \frac{4\,Tut}{r^2} = 4x$$

$$=$$

where
S = Storage Coefficient (dimensionless)
t = time
r = Distance to observation hole (L)
T = Transmissivity ($L^3 t^{-1} L^{-1}$)
Q = Pumping rate ($L^3 t^{-1}$)
Δ = Drawdown (L)
W(u) = function of u

* L = unit of Length
t = time unit

FIG. 6

HYDROGEOLOGY SECTION	DEPARTMENT OF MINES – SOUTH AUSTRALIA	SCALE:
COMPILED: G. H. McN	KALANGADOO TOWN WATER SUPPLY NO. 1 (MA 94)	DATE: 19·5·77
DRN: T.E. CKD:	LEAKY AQUIFER TYPE CURVE COMPARISON	DRG. NO. 77-587

PF Nº 70-494 MH

7022-IV

DEPARTMENT OF MINES - SOUTH AUSTRALIA
ENGINEERING DIVISION

COMPOSITE WELL LOG - GROUNDWATER

HOLE No.	MA 94
UNIT/STATE No.	7022 994 WW 00690
SERIAL No.	39/77
FOLDER No.	
DRG. No.	77-588
SHEET	1 OF 1

CONSTRUCTION DETAILS

DRILLING TECHNIQUE: Cable Tool
CIRCULATION:
START: 15·2·77
FINISH: 3·5·77
TOTAL DEPTH: 118m

	Inches	m.m	From(m)	To(m)
HOLE DIAMETER	15	381	0	5
	10	254	5	101
	8	203	101	108
	5	152	108	118
CASING DIAMETER (Cemented)	10	254	0	13·5
	8	203	0	98
CASING DIAMETER (Uncemented)	15	381	0	1·3
	5	127	86	104·9
	5 (tailpiece)	127	113·03	117·8
SCREEN DETAILS Make / Model Dimensions	4	124 (O.D.) 113 (I.D.)	104·9	113·03
	Surescreen S/Steel			

PROJECT KALANGADOO TOWN WATER SUPPLY NO. 1
(Project No. MA 94)
LOCATION
SECTION 414 HUNDRED GREY
CO-ORDINATES
LOGGED BY A. F. WILLIAMS
REFERENCE ELEV. DATE
SURFACE ELEV. TRACED BY TJE
DATUM DATE 24th JUNE 1977

TYPE OF LOG	16 IN. NORMAL	64 IN. NORMAL	6 FT. LATERAL	S.P.	POINT RESISTIVITY	NEUTRON	GAMMA RAY	TEMPERATURE	
DATE OF RUN						18·5·77	18·5·77		
FIRST READING (m)									
LAST READING (m)									
INTERVAL MEASURED (m)									
CASING: LOGGER (m)									
CASING: DRILLER (m)									
DEPTH REACHED (m)									
BOTTOM: DRILLER (m)									
MUD TYPE									
MUD RESISTIVITY									
RECORDED BY									

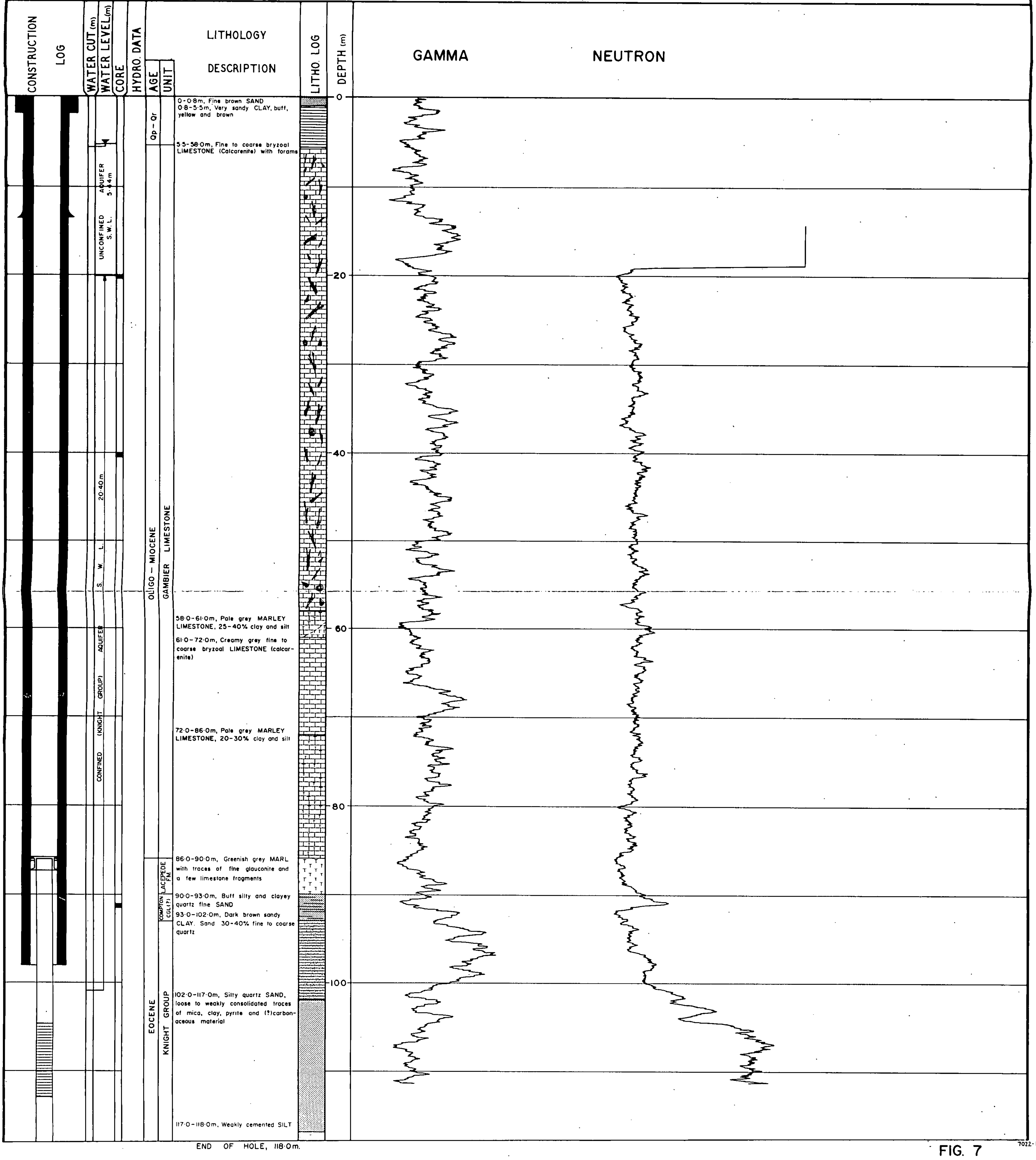
WELL SYMBOLS

CONSTRUCTION LOG
- Casing seal
- Casing shoe
- Wire wound screen
- Slotted casing
- Cemented Interval
- Gravel packed Interval

HYDROGEOLOGICAL LOG
- ■ Core Interval
- Aq Aquifer
- Cb Confining bed
- T Transmissivity m³/day m⁻¹
- S Storage Coefficient/Specific Yield
- θ Porosity
- K Hydraulic conductivity m/day

DEPTH TO WATER (m)	DEPTH TO S.W.L (m)	YIELD m³/day	YIELD Method of Test	TOTAL DISSOLVED SOLIDS mg./litre	TOTAL DISSOLVED SOLIDS Analysis W No.
5·5	5·5	–	NOT TESTED	691	W 1818/77
101	20·04	1500	72 hour pump test	629	W 3650/77

REMARKS: STANDBY BORE, KALANGADOO T.W.S. NO. 2 BEING DRILLED ADJACENT



END OF HOLE, 118·0m.

FIG. 7
77-588

7022-1