DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Rept.Bk.No. 79/51

PARA WIRRA RECREATION PARK GROUNDWATER SUPPLY

GEOLOGICAL SURVEY

by

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D.M.No. 542/78

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DEPARTMENT OF MINES AND ENERGY
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ABSTRACT

Although the yields of the two completed wells were adequate (380 and 180 kl/day from holes 1 and 2 respectively) groundwater salinities (5000 and 3200 mg/l) were unsuitable for the Park requirements. Further drilling is not recommended.

INTRODUCTION

Departmental drilling was requested by the Public Buildings Department to provide the Para Wirra Recreation Park with a reliable groundwater supply to supplement the existing surface storage. The present maximum daily consumption in summer months is about 220 kl/day (48 000 g.p.day), the bulk of which is used to irrigate the numerous ovals. Quality requirement is for a maximum TDS of 2 000 mg/l.

The Recreation Park is underlain by Archaean gneissic bedrock and as such the prospects of obtaining a reasonable supply of good quality (<2 000 mg/l) water were considered to be poor.

Two sites were proposed - the first site requested by Public Buildings Dept. adjacent to the park lake and existing pipeline and the second site (to be attempted only if site 1 was unsuccessful) suggested by this Dept. next to Hamlins Gully along a possible lineament in bedrock.

Due to high salt content in the first hole, drilling at the second site was carried out. Drilling operations with a rotary percussion rig were carried out between 25/1/79 and 2/2/79.

Well discharge testing of the two wells was completed on 16/2/79.

DRILLING RESULTS

Well locations are shown in Fig. 1 and geological logs included in Appendix 1. In both holes, salinity of water increased markedly from the time of drilling to when wells were pump-tested.

Hole 6628 170WW 08928, adjacent to Lake.

Depth	: 46 m
Casing	: 150 mm to 46 m slotted from 20 to 46 m
Water Cut	: 12 m
Static Water Level	: 3.45 m
Yield	: 380 kl/day
Salinity	: initial 3000 mg/l, final 5500 mg/l
Recommended pump depth	: 40 m
Available draw-down	: 36 m

Hole 6628 170 WW 08929, Hamlins Gully

Depth	: 18 m, backfilled* to 16 m
Casing	: 150 mm to 16 m, slotted 10-16 m
Water Cut	: 10 m
S.W.L.	: 3.5 m
Yield	: short term (11 hrs.) 220 kl/day (2 000 g.p.h.) long term 164 kl/day (1 500 g.p.h.)
Salinity	: initial 1900 mg/l, final 3240 mg/l
Recommended pump depth	: 16 m
Available drawdown	: 12 m

*Drilling was stopped at 18 m due to hole instability in strongly fractured bedrock (10-13 m). While pulling out the drilling rods the hole had partially collapsed from the upper level, reducing effective depth to 16 m. Most of the water supply is obtained from the 10-13 m interval which is strongly fractured with associated quartz veining. More massive felsic gneiss, similar to that obtained in the first hole, was intersected at 17 m. It is considered that any water cut in fractured zones of that rock type would tend to be more saline. The additional cost in drilling a deeper replacement hole in difficult conditions was therefore not justified.

DISCHARGE TEST RESULTS

A 24hr. discharge test was originally specified for the Hamlins Gully well which, as determined from samples collected during drilling, appeared to be of suitable groundwater quality.

However due to the low yield, pumping was stopped after 11 hrs. Because of the limited supply from this well, there is a strong possibility that the more saline Lake well may be required. A short 4 hr. discharge test was therefore also carried out on this well. Results are summarized below.

Hole 6628/8929 - Hamlins Gully.

Pumping rates were increased in four stages from 86.4 kl/day (800 g.p.h.) to 224 kl/day (2 050 g.p.h.) for a maximum drawdown of 9.5 m after 430 minutes. For the final stage of 220 min. pumping rate was reduced to 164 kl/day (1 500 g.p.h.) resulting in a rapid recovery to 8.4 m that remained static for the remaining 140 min. of the test.

Drawdown and recovery values vs. log time have been plotted in Fig. 2 and drawdown curves for various pumping rates are shown in Fig. 3. Because of the effects of both discharge and recharge boundaries, indicated by increasing and decreasing rates of drawdown respectively, a well drawdown equation, which relates drawdown to pumping rates and pumping periods, could not be calculated. (Hydrogeological boundaries are related to permeability changes - a recharge boundary in the above case is probably indicative of a more intensely fractured zone in the hard bedrock). However, as shown in Fig. 3, response to various pumping rates can be estimated. It can be seen that the long term pumping rate on this well cannot exceed 164 kl/day. The well can be pumped at higher rates for short periods e.g. 224 kl/day for about 11 hrs. with recovery between pumping periods.

From the drawdown data an average value of transmissivity of T = 13 m^3/day/m was calculated.

Hole 6628/8928 Lake well.

The well was pumped for 210 minutes, with pumping rates increased from 281 kl/day (2 500 g.p.h.) to 382 kl/day (3 500 g.p.h.)

in 3 stages. Here again, drawdowns and recovery data (Fig. 4) show effects of discharge and recharge boundary conditions. Although of short duration, the test indicates that the well can be pumped at a rate of 380 kl/day for at least 12 hr. pumping periods.

DISCUSSION

The groundwater drilling operations in the Para Wirra Recreation Park were, in terms of quality, unsuccessful. In both wells, salinity increased markedly from the time of drilling to when the wells were discharge tested. Furthermore, in the Hamlins Gully hole, a steady increase in salinity was observed during the 8 hr. discharge test. Here the salinity increased from the initial value of 1900 mg/l obtained when drilling, to 3240 mg/l at the end of the test. In both cases, it appears that a thin zone of fresher groundwater is underlain by saline water, resulting in an overall quality that is unsuitable for the intended use. However, a number of alternatives to make use of the adequate supply from the Lake well are outlined below:

1. establish an independent reticulation system for the groundwater for use in toilets, fire-fighting tanks, etc., and re-grass the ovals with salt-tolerant cooch.
2. mix the groundwater with the lake-water to achieve a desirable salinity. This diluting should be carried out in a holding tank and not in the lake.
3. install a small desalination plant. Recent development has made small scale desalination more altractive. Further information on this aspect can be obtained from C.S.I.R.O. or AMDEL.

In view of the above results and the similarity in rock type in the area it is extremely unlikely that reasonably good quality groundwater (less than 2000 mg/l) can be obtained

in the Recreation Park. Additional drilling is therefore not recommended.

X.P. Sibenaler

APPENDIX 1

Geological Logs

MF32

PROJECT: PARA WIRRA RECREATION PARK GROUNDWATER SUPPLY

LOCATION OR COORDS: SEC. 423 HD. PARA WIRRA El. Surface m EL Ref. Point m Datum

DEPARTMENT OF MINES AND ENERGY—SOUTH AUSTRALIA
ENGINEERING DIVISION

WATER WELL LOG

HOLE NO: 1

UNIT / STATE NO. 6628 170WW 08928

DM 542/78

AQUIFER SUMMARY:	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL TESTED From:	INTERVAL TESTED To:	SUPPLY kilolitres/day*	SUPPLY Test Length (hrs)	SUPPLY Method	TOTAL DISSOLVED SOLIDS milligrammes/litre	Analysis No:
	?12			13	10	1/4	Airlift	3600	W— Field Analysis
	15-38*		12	38	300	1/4	"		
	40	6.3	12	40	400	1	"	5000	W 1209/79.

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK / SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION / AGE
0	3			Top soil and weathered gneissic bedrock fragments	
3	6			Weathered, rounded gneissic bedrock fragments, minor clay.	
6	15		Stained and fractured gneiss.	Strongly stained and fractured basic greiss and minor clay.	
15	46		Fractured basic gneiss.	Dark grey to light grey (depending on % of mafic minerals) felspar rich gneiss. Minor interbeds of phillitic schist. Staining on fracture faces. Minor disseminated pyrite and hematite mineralisation. 43 - 46 m: dense and homogeneous dark grey basic gneiss.	

DEPTH CORE SAMPLE	CASING Dia(mm)	CASING From(m)	CASING To(m)
	150	-0.4	40
	slotted 20-46m		
	Linatex seal set at 20 m		

REMARKS: P. No. 4288 - near Lake. Pump-tested for 4 hrs. - yield of 380 kl/day.

*Numerous water cuts in that interval resulting in a gradual increase in yield

*NOTE: 110 kl / day = 1000gals / hr.

DRILL TYPE: ROTARY-HAMMER

CIRCULATION: AIR

SHEET 1 OF 1

COMPLETED: 31/1/79

LOGGED BY: XPS

DATE 31/1/79

PROJECT: PARA WIRRA RECREATION PARK GROUNDWATER SUPPLY

LOCATION OR COORDS:

SEC. 423 HD. PARA WIRRA El. Surface m El. Ref. Point m Datum

DEPARTMENT OF MINES AND ENERGY—SOUTH AUSTRALIA
ENGINEERING DIVISION

WATER WELL LOG

HOLE NO: 2

UNIT / STATE NO. 6628 17[illegible]WW 08929

DM 542/78

AQUIFER	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL TESTED From:	INTERVAL TESTED To:	SUPPLY kilolitres/day*	SUPPLY Test Length (hrs)	SUPPLY Method	TOTAL DISSOLVED SOLIDS milligrammes/litre	Analysis No:
SUMMARY:	10 m ? 13	3 ? 3.5	10 10	11 13	330 440	½ ½	Airlift "	1850 2640	W — Field Analysis
					164	11	Pump	3240	W 1165/78 W 1171/79

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK / SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION / AGE	DEPTH CORE SAMPLE	CASING Dia(mm)	CASING From(m)	CASING To(m)
0	4			BROWN silty and sandy top soil			150	0	16
4	8		Stained, broken granitic greiss with quartz veining	Weathered granitic gneiss, with large white quartz fragments.			Slotted	10	- 16m
8	17		" "	Weathered, strongly stained broken granitic gneiss fragments with up to 50% quartz fragments with common Feoxide coating. Between 5-15% clay nodules. Very fast drilling penetration. - Hole unstable					
18	18		Dark grey basic greiss	Coarse dark grey mafic gneiss. Minor quartz fragments.					

REMARKS: HAMLINS GULLY
P. No. 90094
Unstability of hole between 8-17m prevented deeper drilling. Only able to case hole to 16 m due to collapse. Airlift yield through slotted casing reduced to 100 kl/day.

*NOTE: 110 kl / day = 1000gals / hr.

DRILL TYPE: ROTARY-HAMMER

CIRCULATION: AIR

SHEET 1 OF 1

COMPLETED: 2/2/79

LOGGED BY: XPS

DATE: 2/2/79

APPENDIX 2

WATER ANALYSES

Hole 1, near Lake. (DME NO. 6628 170WW 08928)

SAMPLING TIME	CONDUCTIVITY (µS at 25°C)	SALINITY (mg/1)	pH	Analysis No.
Start Developing	9300	6000	6.7	W 1161/79
End of Stage 1	8600	4850	6.3	W 1162/79
End of Stage 2	8600	4850	6.3	W 1164/79

Hole 2 - Hamlins Gully (DME NO. 6628 170WW 08929)

SAMPLING TIME	CONDUCTIVITY (µS at 25°C)	SALINITY (mg/1)	pH	Analysis No.
Start Developing	4500	2640	6.9	W 1165/79
End of Stage 1	5100	3035	6.5	W 1166/79
End of Stage 2	5000	2970	6.3	W 1167/79
End of Stage 3	5000	2970	6.7	W 1168/79
300 mins. from Start	5200	3100	6.4	W 1169/79
480 mins. " "	5400	3240	6.3	W 1171/79

FIGS. 1-4

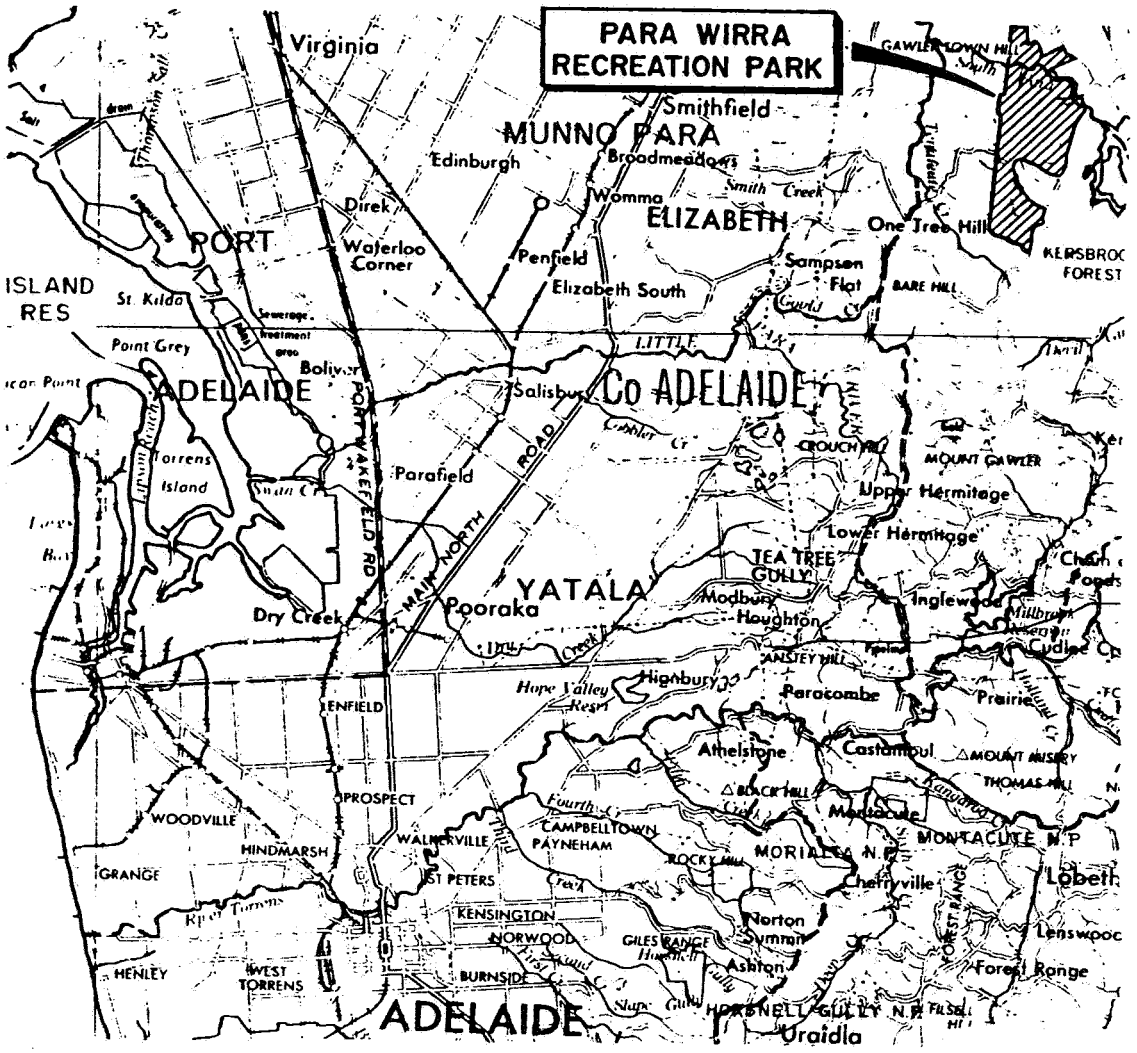


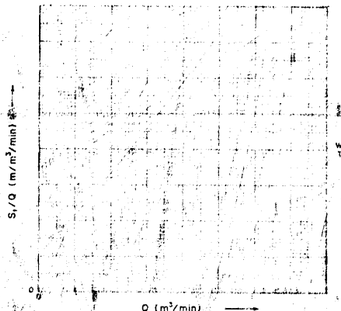
Fig. 1

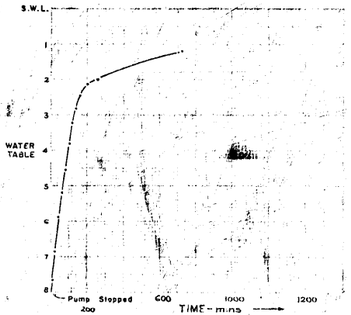
	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE 1 : 250,000 1 : 10,000
COMPILED: X. P. S.	PARA WIRRA RECREATION PARK	DATE: MARCH 1979
DRN M. R. CKD	LOCALITY PLAN	PLAN NUMBER S 13950

STATE / UNIT No. OF WELL 6628170WW08929

REF. PT. .....(m) above ground
AQUIFER FROM... 10 .....TO... 13 ...(m)
HOLE DEPTH.... 16 .....(m)
AQUIFER TYPE. Semi-confined...
LITHOLOGY. Quartz & gneiss fragments

TYPE OF PUMP..... MONO.....
LENGTH OF TEST..... 11 hours .....
DEPTH PUMP INTAKE (ℓ_1)... 15 ...(m)
DEPTH WATER LEVEL AT TEST START (ℓ_2)... 3·5 .....(m)
AVAILABLE DRAWDOWN... 11·5 ...(m)





	Q (m³/min)	$S_1 = 1$	$\frac{S_1=1}{Q}$	$S_1 = 10$	$\frac{S_1=10}{Q}$	$S_1 = 100$	$\frac{S_1=100}{Q}$	Δs	$\frac{\Delta s}{Q}$
STEP 1	·06			1·9	31·7			1·1	18·3
STEP 2	·092			2·75	30			1·84	20
STEP 3	·135			3·8	28			2·3	16
	·155			4	26			3·2	20

WELL EQUATION $S_1 = aQ + cQ^2 + bQ\log_{10}t$

or $S_1/Q = (a + b\log_{10}t) + cQ$

From S_1/Q versus Q $a =$ TRANSMISSIVITY $= \frac{0.183Q}{\Delta s}$

$b =$

$c =$ $= 13$ $(m^3/day/m)$

THEREFORE WELL EQUATION $S_1 = Q + Q^2 + \log_{10}tQ$

FIG. 2

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE —
COMPILED X.P.S.	PARA WIRRA RECREATION PARK DISCHARGE TEST WELL No. 6628170WW08929	DATE MARCH 1979
DRN M.R. CKD		PLAN NUMBER 79 – 283

P.F. No. 39–853 MH

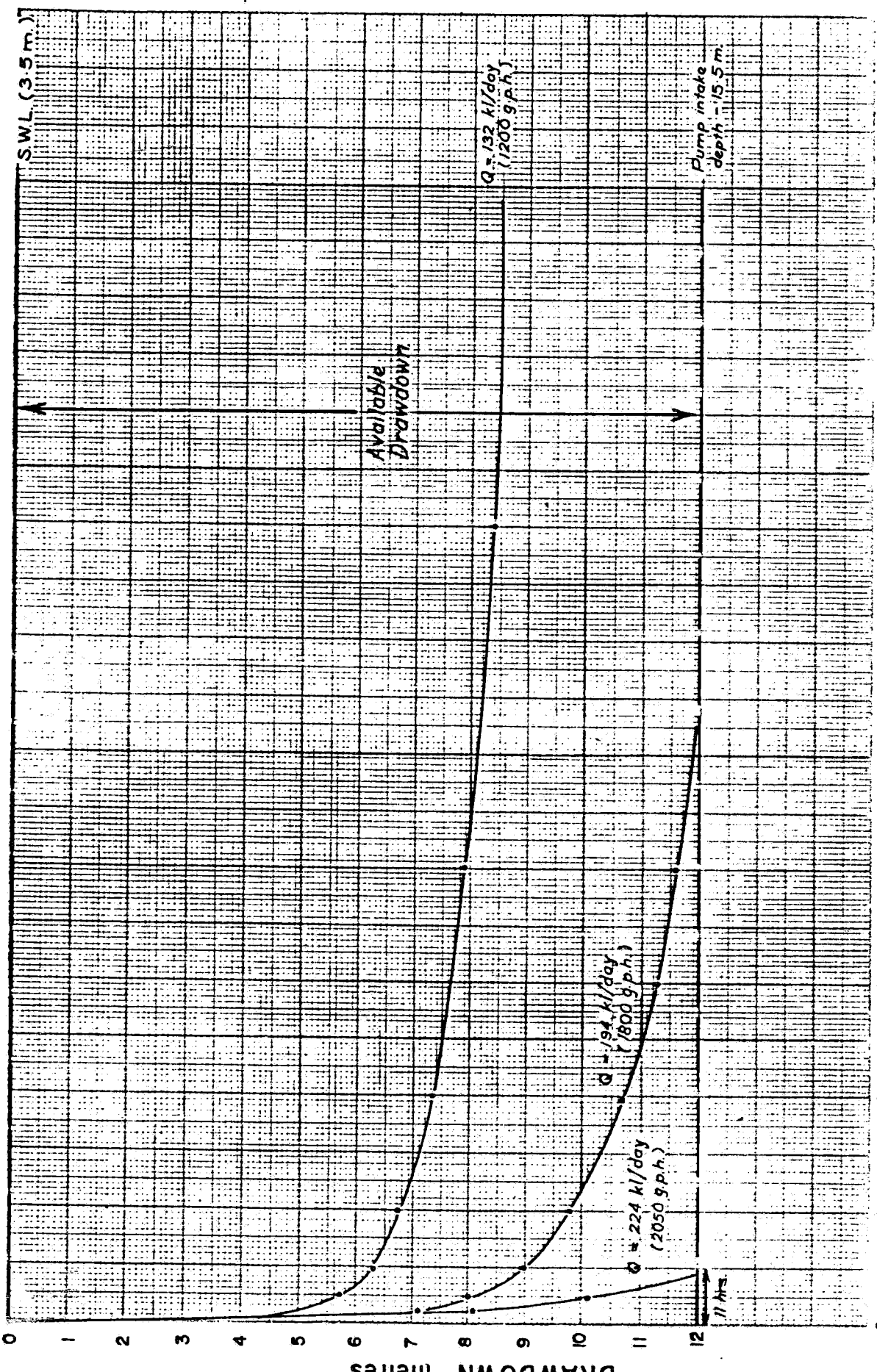


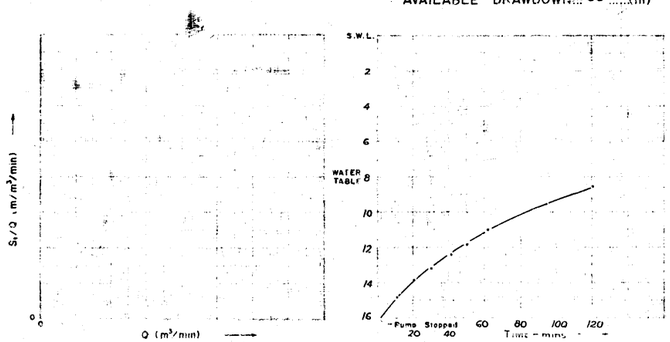
Fig. 3

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE —
COMPILED X.P.S.	PARA WIRRA RECREATION PARK	DATE MARCH 1979
DRN M.R. CKD	DRAWDOWN CURVES FOR VARIOUS PUMPING RATES-WELL No. 6628/8929	PLAN NUMBER S 13951

STATE / UNIT No. OF WELL 6628170WW08928

REF. PT..... (m) above ground
AQUIFER FROM.....TO..... (m)
HOLE DEPTH... 46.....(m)
AQUIFER TYPE.. Semi-confined...
LITHOLOGY..... Gneiss.....

TYPE OF PUMP..... MONO.....
LENGTH OF TEST..... 240 mins.....
DEPTH PUMP INTAKE (ℓ_1).. 40 ...(m)
DEPTH WATER LEVEL AT TEST START (ℓ_2)... 3·45....(m)
AVAILABLE DRAWDOWN... 36 .....(m)



	Q (m³/min)	$S_1 = 1$	$\frac{S_1}{Q}$	$S_1 = 10$	$\frac{S_1}{Q}$	$S_1 = 100$	$\frac{S_1}{Q}$	Δs	$\frac{\Delta s}{Q}$
STEP 1									
STEP 2									
STEP 3									

WELL EQUATION $S_t = aQ + cQ^2 + bQ\log_{10}t$

or $S_t/Q = (a + b\log_{10}t) + cQ$

From S_t/Q versus Q a = b = c =

TRANSMISSIVITY = $\frac{0{\cdot}183Q}{\Delta s}$ = (m^3/day/m)

THEREFORE WELL EQUATION $S_t = Q + Q^2 + \log_{10}t\,Q$

FIG. 4

s = DRAWDOWN (METRES)

t = TIME IN MINUTES OR $1/t_1$

Drawdown
Corrected Drawdown
Recovery

Q_1 = 1281 kl/day
Q_2 = 346 kl/day
Q_3 = 382 kl/day

DRAWN X.P.S.	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE ——
TRACED M.R.	FARA WIRRA RECREATION PARK DISCHARGE TEST WELL No. 6628170WW08928	DATE MARCH 1979 PLAN NUMBER 79 - 284

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P.F. No. 69—953 MH