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BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

1960/81

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PUMPING TESTS AND EQUIPMENT IN THE A.C.T.

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E. G. Wilson

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Contents

SUMMARY

In the Australian Capital Territory the bailing test is the most common method of calculating the output of a bore. This method is inexact and in most cases the results differ appreciably from results obtained by pumping.

A Jack pump and a Venturi pump were used to test a number of water bores, and the results differed from those of the bailing tests. Graphs are presented which show that output decreases as pumping continues; it was also found that the footvalve should be placed near the bottom of the bore. No satisfactory method has emerged by which measured yield at one suction level can be corrected to predict yield at another pumping level in the same bore; therefore, pumping tests should be thorough, and the results should not be extrapolated beyond the limits imposed by the test.

Well conducted pumping tests should be part of the drilling programme in sinking new bores; continuous pumping over much longer periods than have been used in the past is planned to provide some basis for estimating the safe yield of bores.

INTRODUCTION

Water bores in the Australian Capital Territory derive water from fractured crystalline rocks and the overlying weathered mantle. Further information on the aquifers is supplied in the Record "Underground Water Resources of the A.C.T." by G.M. Burton now in preparation. Little is known of the yield of individual water bores in the A.C.T. Preliminary tests showed that bailing tests are inaccurate; the method of conducting bailing tests was therefore investigated. The need for pumping equipment became evident because the only way of obtaining the accurate yield of a bore lies in systematic pumping over a period of time greater than is practicable for bailing tests. Pump tests also play an essential role in the search for underground water supplies capable of supporting small scale irrigation projects.

This record discusses the value of the bailing test; the pumping equipment in use by the Bureau of Mineral Resources is described, and the results of pumping tests carried out to date are discussed.

BAILING TESTS

With the help of drilling companies working in the A.C.T., a study was made of the methods and equipment used in bailing tests. Bailing tests are conducted by lowering a bucket into the bore and withdrawing it full of water; the bucket is a long pipe with a footvalve at its lower end. A record is kept of the quantity of water removed, the period over which bailing is done, and the amount by which the water level in the bore is lowered; the last measure is known as the drawdown.

Bailing tests should fall into one of two categories:-

(1) Where bailing lowers the water level until it is impossible to raise full buckets of water.

(2) Where bailing lowers the water level until it remains stationary even though bailing continues at a constant rate.

In the first case, an estimate of the yield can be made by adjusting the bailing rate to keep the water level stationary. The quantity of water entering the bore will equal the quantity of water being bailed out and may be calculated from the bailing rate. Exact measurement of the water level is desirable, and a probe may be used to measure the distance between the top of the casing and the water level. This method of measurement is only accurate to within a foot because the water level is not stationary, and the time lost in lowering the probe is reflected in the results.

In the second case, the water level remains stationary even though bailing continues, and the bore is capable of delivering more water if bailed at a faster rate, but the drawdown would be greater. The rate of bailing by a small percussion rig rarely exceeds 500 gall. per hour, therefore the maximum output of a bore can be calculated only if additional information on the permeability of the rock type is available. There is difficulty in determining when the water level is stationary; a driller follows movement of water level by noting when his cable slackens on the impact of the bucket with the water, but this cannot be judged with accuracy. A drawdown of one foot per hour is hard to detect, and to assume that the level is stationary when in fact it is still falling can introduce a large error.

The time available commonly limits the duration of a bailing test; even though it is desirable to continue bailing until drawdown ceases, the time is unproductive to the driller and is therefore kept as short as contract on usage permit. The Bureau of Mineral Resources suggests at least one hour for a bailing test, but at the end of this time the test is usually incomplete. In the past some drilling companies have conducted bailing tests over periods as short as ten minutes; such a test is useless. On the other hand long tests of three or four hours cannot be recommended because the value of a bailing test is limited as is shown below. In the absence of other tests the length of the bailing test should be flexible within reason, and should depend on the test results.

A bailing test will not indicate the drop in output that will be obtained when pumping is continuous. In recognition of this fact one reputable manufacturer selects pumping equipment to deliver only half the output indicated by the bailing test.

PUMPING EQUIPMENT

In September 1957 a Jack pump was ordered as the initial step in assembling a mobile pumping unit. A tripod (Plates 1 and 2) complete with hand winch for raising and lowering the pump, and a frame for mounting the pumphead, were constructed by the Department of Works Fitters Shop, Kingston. Small modifications have been made, but the basic equipment is unchanged and has given satisfactory service.

The pump was driven by a Landrover for periods of less than one hour, but for tests of ten hours on private bores, a tractor supplied by the landowner was used. At the Red Hill bore (City 3) a 6-8 H.P. JAP petrol engine (Plate 9), obtained in December 1958, drove the pump. This motor is mounted on a trailer, and the necessary reduction in revolutions per minute for driving the Jack pump is obtained through an intermediate shaft (Plate 8). This motor will be used for future tests.

In December 1958, a Venturi pump unit (trade name Aqua Jet) was obtained. This pump is more readily portable than the Jack pump, and is also powered by the JAP motor; operation of the Venturi pump is fully described in a later section.

Careful handling of the equipment is required to prevent damage to a bore. Danger lies in equipment falling into a bore; this is prevented by the use of a safety clamp at all times. The pump should never be set in an uncased part of a bore where rock fragments may fall from the side and wedge the pump. Casing in a bore may not extend the full length if there is a reduction in the hole size, or if the hole deviates appreciably from the vertical; it is therefore advisable to check the length of casing before lowering equipment. The winch handle should be removed overnight, and all moving parts locked or clamped to prevent tampering with the equipment.

The pumping equipment is listed in Appendix I.

1. THE JACK PUMP

A full day is required to load, transport, and assemble the Jack pump on a bore. The total weight is 17 cwt. A one ton truck and a Landrover can move the equipment in one trip, and two men are required for loading and unloading.

At the bore the tripod is assembled and pulled up into position by the Landrover; the pipes are cleaned and greased, and the pump and pipes lowered into the bore. The pumphead is then placed on a stand over the bore and connected to the pipes and pumprods. Lastly, a section of fire hose is clamped to the delivery pipe to lead the water away from the pumphead to two 44 gallon drums where the output is calculated from the time taken to fill a drum.

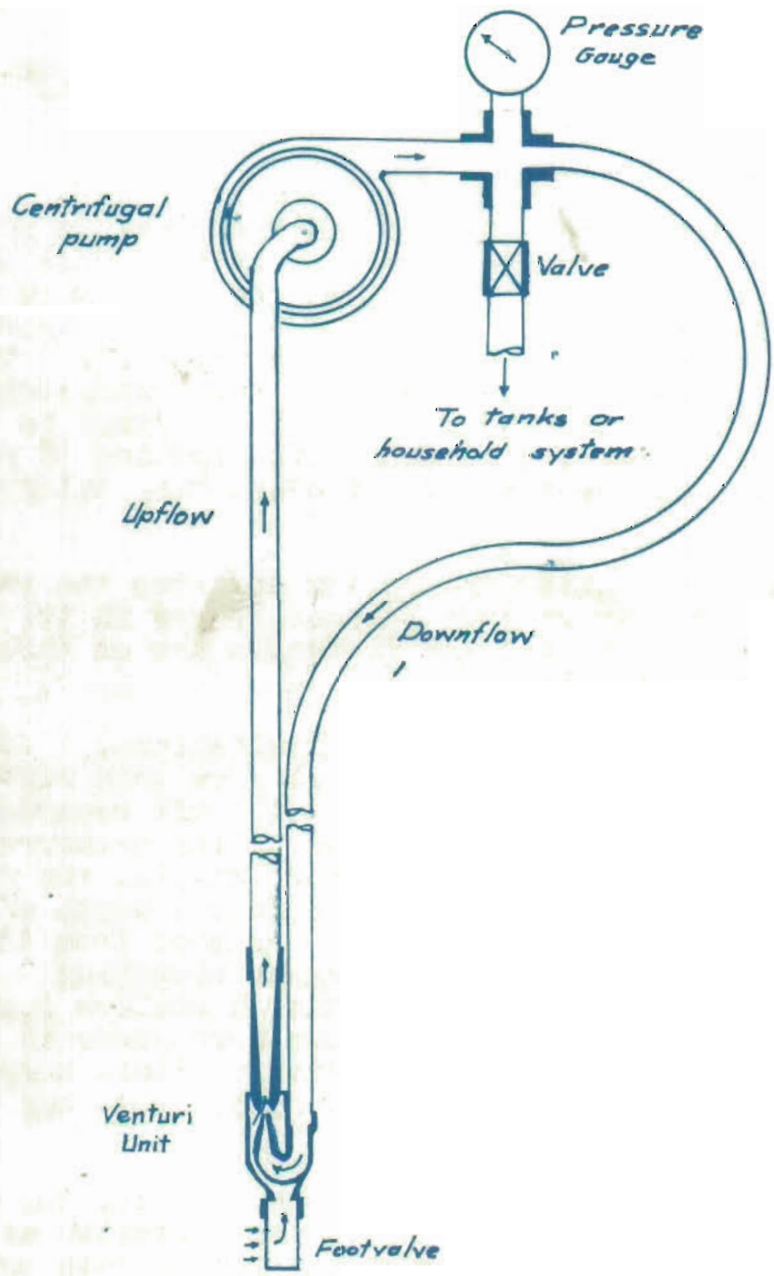
Once pumping commences, the speed of the motor is regulated so that pumping proceeds at a rate greater than the expected output of the bore. The water level in the bore will then fall until it reaches the level at which the pump is set. When this takes place the pump is sucking air as well as water, and the bore is said to be forked. While the water in the bore is kept at pump level, the output is the maximum the bore can supply. The yield of the bore may be overestimated before commencement; this will become apparent after the bore is forked, and a smaller stroke on the pumphead may be desirable. It may also happen that the yield of the bore has been under-estimated, in which case it will be impossible to fork the bore because the stroke is too short. In both instances, pumping is stopped, the stroke is changed, and the test starts again. The variable stroke of the pumphead allows the pump to operate over a wide range of capacities.

Once the bore is forked, the speed of the motor is reduced until the pump is delivering all the water supplied by the bore, together with a small amount of air. The output in gallons per hour is regularly calculated, and is plotted against the time elapsed since commencement of pumping. A copy of this graph is supplied to the landholder so that the bore can be suitably equipped.

Text Fig. 1

VENTURI TYPE PUMP

DIAGRAMMATIC SKETCH



2. THE VENTURI PUMP.

The Venturi pump is lowered into the bore on two polythene pipes (text fig. 1). On top of the bore these pipes are connected to a centrifugal pump which forces water down one pipe. As the circulating water passes through a nozzle at the lower end of the pipes, reduction in pressure draws additional water into the pump, and this is carried to the top where part of the water is drawn off into tanks or into a household system.

The Venturi pump is light in weight, and can be lowered into a bore at any time during drilling; pumping for a few hours will then disclose the short-term yield of a bore and indicate whether drilling should continue. This information is invaluable to landholders when drilling for water. The pump should not be lowered into any part of a bore which is uncased, otherwise caving of the walls may jam the pump in the bore.

The benefits mentioned in the previous paragraph are offset by a number of disadvantages which demand care in operating the equipment. The pump and pipes must be fully primed with water; if any air remains in either the pipes or centrifugal pump, the pump will not work. The pump can be most easily primed from the town water supply beforehand; hand filling and removal of air locks is a long and tedious process. Further investigation of priming technique may find a surer method of overcoming delays in hand priming.

Air will enter the system and stop the pump if the footvalve is sticky or grit becomes lodged in it; therefore, it is wise to set the footvalve two or three feet above the bottom of the bore.

The equipment has other limitations. Maximum efficiency is obtained when the hole is less than sixty feet deep; at greater depths, efficiency falls off because more power is used to provide the higher operating pressures necessary to circulate the water. For example, the pump is capable of drawing 1800 gall. per hour from a depth of 30 feet, but it will only draw 250 fall. per hour from 120 feet. To pump from deep bores requires a higher operating pressure, and therefore more power than at shallow depths. The present motor runs near its maximum horsepower to operate the Venturi pump, therefore it is better to limit pumping to short tests of a few hours; longer pumping tests can be carried out by the Jack pump.

While pumping with the Venturi pump, the water level in the bore must not fall below the footvalve as this would permit air to enter the sytem and necessitate priming once again. The operator must constantly know the water level to avoid this trouble, and it is found by measuring the air pressure exerted by the column of water in the bore. An open ended plastic hose is lowered into the bore, and the upper end of the hose is connected to both a pressure gauge and a valve, air is pumped into the hose through the valve; when the water level falls, the pressure in the hose is lowered, and the gauge registers a drop of 0.434 pounds per square inch for each drop of one foot in the water level. This pressure device has not been available for tests carried out to date.

PUMPING RESULTS

The duration of pumping tests may vary according to the amount of water required. If the bore is for household use where only a small amount of water will be pumped at any one time, a ten hour test will generally give all the information required. If the bore is to be used for irrigation, pumping may be continuous for a week or more, and a pump test over such a period is desirable before equipment is installed.

The South African Bureau of Standards recommends that pumping should be maintained at the maximum rate until a uniform discharge is maintained for six consecutive hours. The uniform discharge is known as the maximum yield of the bore under the test conditions. They also recommend as a general rule, that the pumping rate should not exceed 60% of the maximum yield determined by the test. This may be referred to as the safe yield, but it is strongly recommended that geological advice be obtained on the percentage to be adopted in each case.

In the Australian Capital Territory the supply of water from bores is usually less than 1000 gallons an hour, and pumping tests carried out to date have been over a period of ten hours. These tests have given adequate guidance as to the type of pump required because all bores have been for intermittent rather than continuous usage. The yield of a bore will vary with the climate, and with the number of bores in the neighbourhood; the effect of drought on the yield of bores in the A.C.T. has not yet been observed, but regular water levels are now being recorded and periodic pump tests are planned to permit a comparison to be made in the future.

The point of suction could not always be placed as near to the bottom of the bore as seemed desirable, because the length of the pump string can only be varied by units of 10 feet 6 inches. To enable the point of suction to be set as low as possible in the bore, a second footvalve was placed on an extension pipe below the footvalve incorporated in the pump. The distance between these footvalves should not exceed 15 feet for efficient operation; this arrangement was tested at BUNGENDORE 1 and CITY 3 (pp. 9 and 11).

Results are presented graphically by plotting output against time, and the practical value of each test is assessed in the pages that follow. Figure I displays all the results on one sheet and enables comparisons to be made; figures II and III show the graphs for each bore. Figure IV shows the output for each bore plotted against log time. Pumping tests conducted by the Bureau of Mineral Resources have been carried out with the Jack pump on all the bores; at the City 3 bore both pumps were used.

Pumping tests have been carried out on the following bores and Table 1 summarizes the results.

B.M.R. Bore No.	Landholder	Reference Map Sheet and Co-ordinates
CITY 2	G. Pini, Narrabundah Lane, NARRABUNDAH.	Canberra 1 mile military sheet. 172342
CITY 3	Lessee 11 Torres Street, RED HILL.	Canberra 1 mile. 135374
HALL 6	J.J. Goslett HALL.	Canberra 4 mile. 198656
HALL 7	J.J. Goslett HALL.	Canberra 4 mile. 200659
HALL 9	C. Moore, "Glenmoor", HALL.	L. George 1 mile. 006536
BUNGENDORE 1	F.N. Braund, "Foxlow", BUNGENDORE.	Canberra 1 mile. 396236

TABLE 1

BORE	COUNTRY ROCK	DEPTH OF BORE FEET	DEPTH TO POINT OF SUCTION FEET	BAILING TEST RESULT GALL. PER HOUR	MAXIMUM YIELD PUMPING TEST GALL. PER HOUR
City 2	Fractured porphyry	64	34	inconclusive	? 300
City 3	" "	100	92	-	600
Hall 7	" "	80	65	> 515	? 900
Hall 6	" "	80	54	? 300	inconclusive
Hall 9	" "	60	56	> 700	1680
Bungendore 1	unknown	150	133	1152	760

CITY 2 (Fig. 2)

Depth 64 feet
Suction 34 feet

Pump Test

The pump suction was set at 34 feet because the hole was uncased below 35 feet. The graph shows that there was still a fall in output below 400 gall. per hour at the end of $7\frac{1}{2}$ hours, and clearly illustrates the decrease in output with continuous pumping.

Bailing Test

The bailing test indicated in the last 20 minutes of an 80 minute test that the bore supplied water at a rate of 560 gallons per hour. If the pump had been set at about 60 feet, the graph may have passed through the bailing line. (See dotted line).

Discussion

This pumping test is inadequate as a guide for equipping the bore because it gives no indication of the maximum yield with the pump set near the bottom of the bore. It would undoubtedly yield water at a greater rate, and an increase of 100 gallons per hour may be obtained; however, this cannot be predicted with any degree of certainty.

CITY 3 (Fig. 2)

Depth	100 feet
Suction	92 feet

The bore was drilled as a research hole for investigating the possibility of lowering the water table by pumping. The results of this work are incorporated in Wilson and Noakes (1959).

Pump Test

The Jack pump was used, and an additional footvalve was set at 92 feet, thirteen feet six inches below the pump footvalve; this arrangement operated satisfactorarily. The graph is a true presentation of the output of this bore for short periods; a fall of approximately 20 gallons per hour took place during the ten hours, the maximum yield being 600 gallons per hour.

Discussion

No bailing tests were conducted on this bore, but the Venturi pump was used immediately after drilling. The pump could not be lowered below 60 feet due to a reduction in hole size, but a constant output of approximately 225 gall. per hour was maintained. Subsequent pumping from 50 feet with the Jack pump yielded 460 gall. per hour. The reduced yield by the Venturi pump was attributed to the presence of drilling mud in the hole, and it is interesting to note that the output was reduced by half.

HALL 9 (Fig. 2)

Depth	60 feet
Suction	56 feet

Pump Test

This bore has a very high yield with no apparent drop in output after 90 minutes. The installation was satisfactory, and the maximum yield of 1680 gall. per hour is exceptional. The only limitation in applying the result lies in the brevity of the test.

Bailing Test

During the bailing test 805 gallons of water were removed in 69.25 minutes at an average rate of 700 gallons per hour. The water level was lowered from 4' 10" to 13' 9" giving a drawdown of 8' 11"; the water level was stationary at the end of the test. This bailing test was the only one to reach completion. From the small drawdown, it is clear that the bore can produce more than 700 gall. per hour for short periods; how much more is not determined. A rough and conservative estimate would place the maximum yield at about 700 gallons per hour.

It is readily seen that the bailing test is no guide where yields in excess of the bailing rate are encountered.

HALL 7 (Fig. 3)

Depth	80 feet
Suction	65 feet

Pump Test

The pump suction was set at 65 feet instead of 75'6" because partial silting up of the bore below 75 feet choked the strainer on the footvalve and the pump would not operate from that level. The graph shows that the output was still falling below 870 gall. per hour at the end of six hours, but rain and a slipping belt marred the last few hours of the test.

Bailing Test

The bailing test removed 700 gallons of water in 81½ minutes at a rate of 515 gallons per hour, and the water level was lowered from 26' 5" to 42' giving a drawdown of 16 feet. At the end of the test the water level was still falling at a rate of 18" for every 140 gallons removed, therefore the bore was not yet supplying water at a rate of 515 gallons per hour, and the bailing test was incomplete. It was possible that the bore would stabilise with the water level at about 50 feet, in which case the maximum output would be greater than 515 gall. per hour. No indication of how much greater the maximum yield may be was possible without bailing at a faster rate. There is the alternative that the water level would not stabilise, but would continue to fall; this, however, is not substantiated by the drillers' report that water entered hold after fracturing a number of hard bands below 40 feet.

The only possible conclusion from the bailing test was that the bore was probably capable of giving a maximum output in excess of 515 gallons per hour over a short period of time.

Discussion

The pumping test, which was not entirely satisfactory, shows the bore has a maximum yield in the vicinity of 900 gall. per hour; the yield would be higher with the pump at a lower level.

HALL 6 (Fig. 2)

Depth 80 feet
Suction 54 feet

Pump Test

This bore is cased with 5 inch casing, the internal diameter of which is $4\frac{3}{8}$ inches; the internal diameter is further reduced by drops of metal which adhere inside the casing near perforations. It was found impossible to lower the pump (diameter $4\frac{3}{8}$ inches) below 54 feet.

A gradual fall off in output of the bore took place throughout the day; it was still decreasing after ten hours pumping, therefore the graph does not indicate the maximum yield of the bore. The final figure of the day was 230 gall. per hour. The output of the bore with a pump set at 80 feet cannot be found without pumping from that level.

Bailing Test

The bailing test removed 735 gallons of water in 85.5 minutes at approximately 515 gallons per hour. The water level was lowered from 24' 11" to 51' 8", giving a drawdown of 26' 9"; when the test ended, the water level was falling 15 inches for every 70 gallons of water removed. At the end of the test, the bore was contributing about 400 gallons per hour and it is doubtful whether any increase on this figure would have been found if the bailing test had been prolonged. A maximum output of 400-500 gallons per hour over a short period may be possible but over ten hours the maximum yield may be less than 300 gallons per hour. This figure is not arrived at mathematically and is unreliable; it is merely a rough estimate based on experience.

It is unfortunate that the pumping test figures cannot be used to determine the maximum yield.

BUNGENDORE 1 (Fig. 3)

Depth 150 feet
Suction 133 feet

Pump Test

This bore had not been used since it was drilled in December 1954, and in plotting the graph, two irregularities show up.

After five hours the output of the bore increased from 765 gall. per hour to 800 gall. per hour, and was accompanied by discolouration of the water. An accumulation of silt outside the casing during the $3\frac{1}{2}$ years of idleness is thought to have reduced the permeability of the gravel. The silt was disturbed by the pumping, and once it was removed, an increase on output was observed.

After $6\frac{1}{2}$ hours pumping the delivery rate became erratic. Output of the bore was being calculated from the time taken to fill a 44 gallon drum, and this time fluctuated between $2\frac{1}{2}$ and $3\frac{1}{2}$ minutes. This behaviour was probably due to faulty or irregular operation of one of the footvalves; two footvalves were used, the lower one being placed 12 feet below the footvalve in the pump. To minimise these errors, the frequency of measurements was trebled over the last 3½ hours.

The output of this bore was probably steady at the end of ten hours but the irregular operation of the pump at this stage made assessment difficult. The <u>maximum yield</u> of the bore is in the vicinity of 760 gallons per hour.

Bailing Test

The bailing test was carried out by the drilling company and the log shows that the water level was lowered from 13 feet to 81 feet, and became stationary at 81 feet. The time over which the test was carried out is unknown but the bailing rate would not have exceeded 550 gall. per hour from such a bore. The yield calculated was 1152 gall. per hour. The supply in this case was recognised as being greater than the bailing rate, but the figure above is far in excess of 760 gall. per hour - the <u>maximum yield</u> of the bore from the pumping test.

CONCLUSIONS

This investigation has proved that the only accurate method of testing a water bore is by pumping; however, a number of factors affect the accuracy of pumping tests.

The output of a water bore with the pump suction at one level cannot be calculated from results obtained when pumping was carried out from a different level. To obtain maximum output the suction should be near the bottom of the bore. Pumping at City 3 from 50 feet disclosed a reduction of 25% on the output with the pump suction at 90 feet.

By comparison with the pumping test, the information from well conducted bailing tests is inadequate, and is commonly misleading. At Hall 9, it was known from the bailing test that there was a good supply ofwater, but if pumping tests had not been carried out, the landholder may never have known that the bore could supply enough water for small irrigation projects.

The Venturi pump has the advantage of mobility over the Jack pump and is useful when lifting facilities are not available at the bore. Unfortunately, the polythene pipes are liable to damage, and care is required both in handling the equipment and in conducting the test.

With a drilling rig on the spot, there is no reason why drilling companies could not conduct pumping tests using a Jack pump. The pump, pumprods, and pipes can be lowered into the bore by the drilling rig. At the top, a standard Tee piece is used, and a pumphead is not required. The drilling rig drives the pump rods. This system is used extensively in the Northern Territory. If this service were offered as an alternative to the bailing test, many landholders would be prepared to pay for a pumping test on an hourly rate to gain the information by which the bore can more efficiently be equipped.

A graph of the pumping test has been found a satisfactory guide to landowners, and manufacturers recommend suitable equipment with confidence after considering the projected frequency and duration of pumping, in conjunction with the pumping graph.

Pumping tests carried out to date show that the output of a bore decreases as time since pumping commenced increases. Future tests will be carried out over periods of two to three weeks, and should lead to a method of determining <u>safe yield</u>.

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APPENDIX I

JACK TYPE PUMP

I.B.C., Type A.40, Flush-type, Deep-well Pump (Plate IV)
Internal diameter 4 inches.
External diameter $4\frac{3}{8}$ inches.
Stroke 20 inches.

I.B.C., Type A.26, Double-geared Pumphead with variable stroke (10", 12", and 14"). (Plate VI).

210 feet $2\frac{1}{2}$ inch galvanised iron pipe (to connect pump and pumphead). (Plate V).

210 feet $\frac{3}{4}$ inch hollow pumprods with tapered joints (to drive pump from pumphead). (Plates IV & V).

300 feet condemned fire hose to attach to 2 inch delivery pipe on pumphead.

20 foot tripod complete with pulley block, hand winch and wire rope. (Plates I & II).

Accessories: Two crescent spanners, two Stillson wrenches, knock and catch wrenches, one pipe clamp, one swivel lifting plug, one flat leather belt, one footvalve $2\frac{1}{2}$ inch flush-type, one $2\frac{1}{2}$ inch bolted clamp, rope blocks and pulleys etc.

The specifications of the pumphead are as follows:

Lengths of stroke available: 10", 12", and 14".
Back geared: 7:1.
Fast and Loose Pulleys: 16" x 3".
Pulley speed: 245 R.P.M. Max.
Discharge Tee Screwed: 3" pipe.
Delivery Screwed: 2" pipe.
Plunger Rod Screwed: $\frac{1}{2}$" gas thread.
Speed not to exceed 35 strokes/minute.
Power required to operate: 3 H.P.

Capacity: 4" Pump at 35 strokes per minute and 3 H.P. motor.

	Elevation	Gallons/hour
14" stroke	165 feet	1218 (1260)
12" stroke	195 feet	1049 (1085)
10" stroke	235 feet	875 (905)

The capacity of this equipment is slightly less than that quoted by the manufacturer (see figures in brackets above) because the pump rods in use are larger than those normally supplied with this unit; the volume of water delivered with each stroke is correspondingly reduced.

The makers point out that speed in excess of 35 strokes per minute is at the owner's risk and the I.B.C. warranty thereby cancelled. It was necessary to exceed this limit on occasions, but the period of time involved was always small.

VENTURI TYPE PUMP

No. 5 "Aqua-jet" Pressure Unit consisting of a high-head centrifugal pump (2" x 1½") mounted on a steel baseplate and a No. 5 Ejector body fitted for 1½" and 1¼" polythene pipes, also a high pressure 1½" footvalve. (Plate X).

120 feet 1½" black polythene pipe
120 feet 1¼" black polythene pipe

Pumping Capacity

1800	g.p.h.	from	30	feet	operating	pressure	30 p.s.i.
900	"	"	90	"	"	"	30 "
250	"	"	120	"	"	"	50 "

The polythene pipe on this unit is a special NILEX polythene pipe designed to operate at pressures up to 90 lbs. per sq. inch as compared with 65 lbs. per sq. inch for the polythene piping. This has permitted the use of 1½ and 1¼ inch piping instead of the 2 and 1½ inch piping normally supplied with this unit; the reduction in size of the pipes also permits the pump and pipes to be lowered into 5 inch casing if necessary.

MOTOR

J.A.P. Air-cooled Petrol Engine
MODEL 5B 6.75 H.P. 4 stroke (Plates VIII & IX)

General Specifications:

Bore	80 mm.
Stroke	82 mm.
Cubic capacity	412 cc.
B.H.P.	8 at 2700 r.p.m. max. power 6.75 " 2700 r.p.m. 12 hour rating.
Weight	112 lbs.

Plate I

Tripod - showing method of lowering pipes.

Plate II

Hand Winch attached to leg of Tripod.

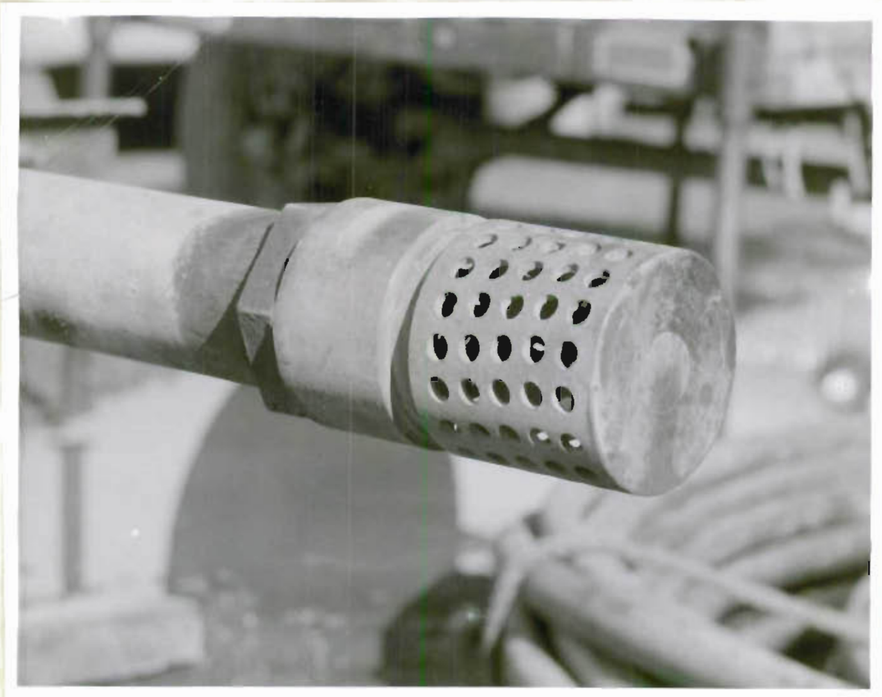


Plate III Footvalve used on an extension pipe and placed below the pump.

Plate IV Type A40, flush-type, Deep-well Pump. Jack pump.

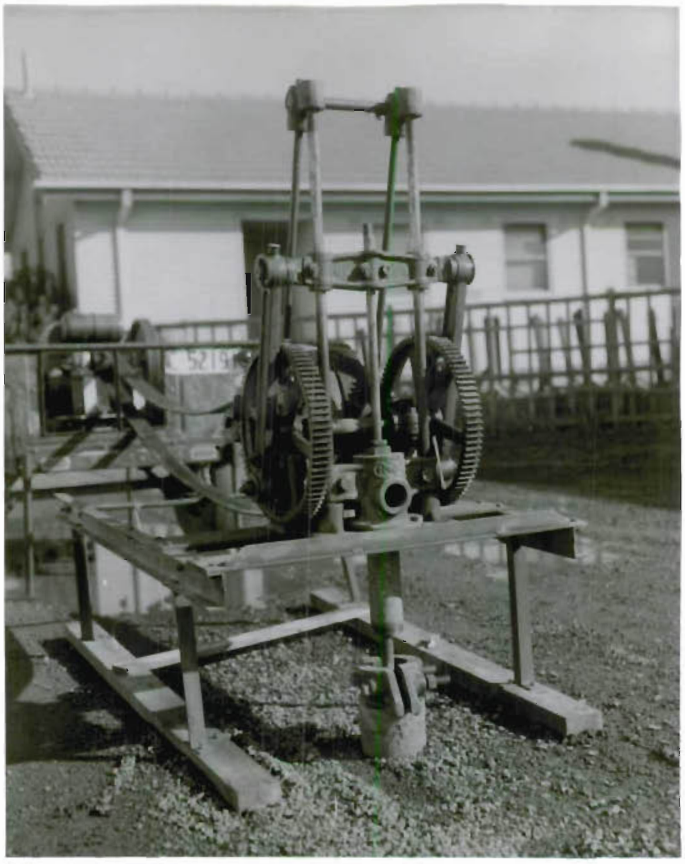


Plate V: Type A.26, Double-geared Pumphead for Jack pump

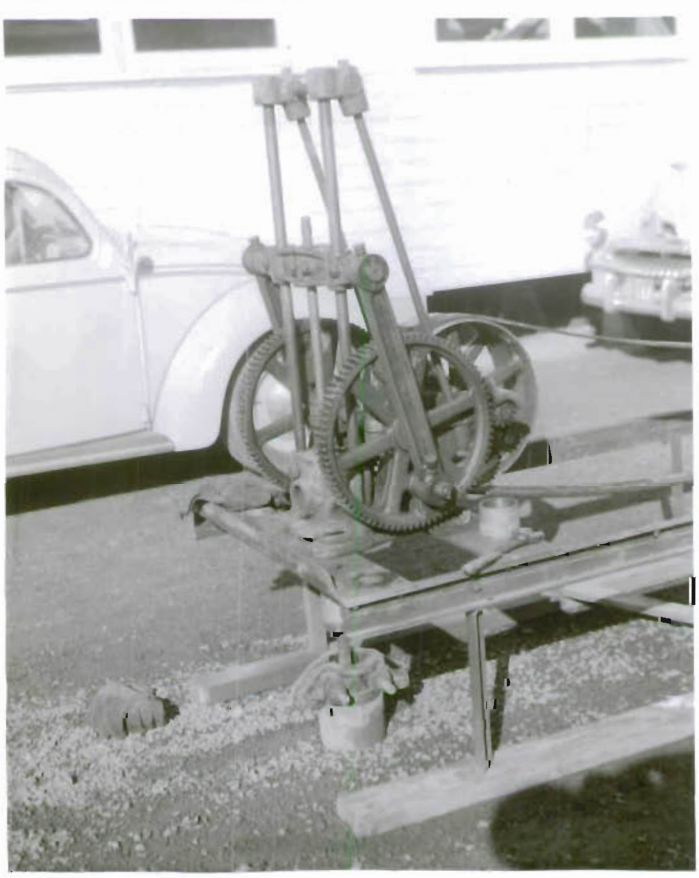


Plate VI: Type A.26, Double-geared Pumphead with variable stroke for Jack pump.

N.B. length of stroke varied by attaching connecting rod to required point on the large gear wheel.
Positions I, II, or III.

Plate VII A.26, Pumphead showing belt-drive from intermediate shaft near motor.

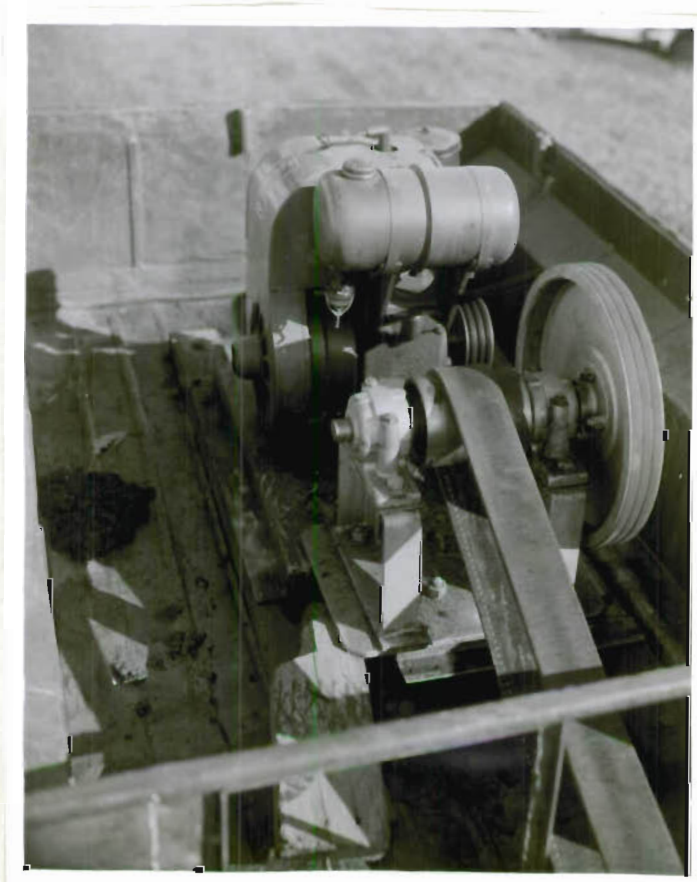


Plate VIII J.A.P. Petrol Engine Model 5B and intermediate shaft.

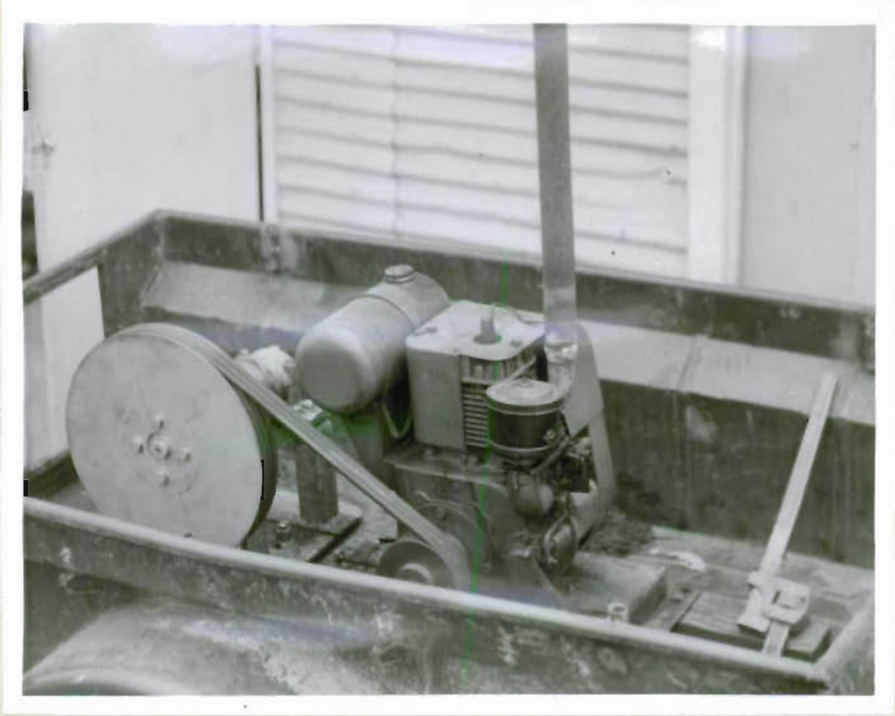


Plate IX J.A.P. Petrol Engine Model 5B
and intermediate shaft.

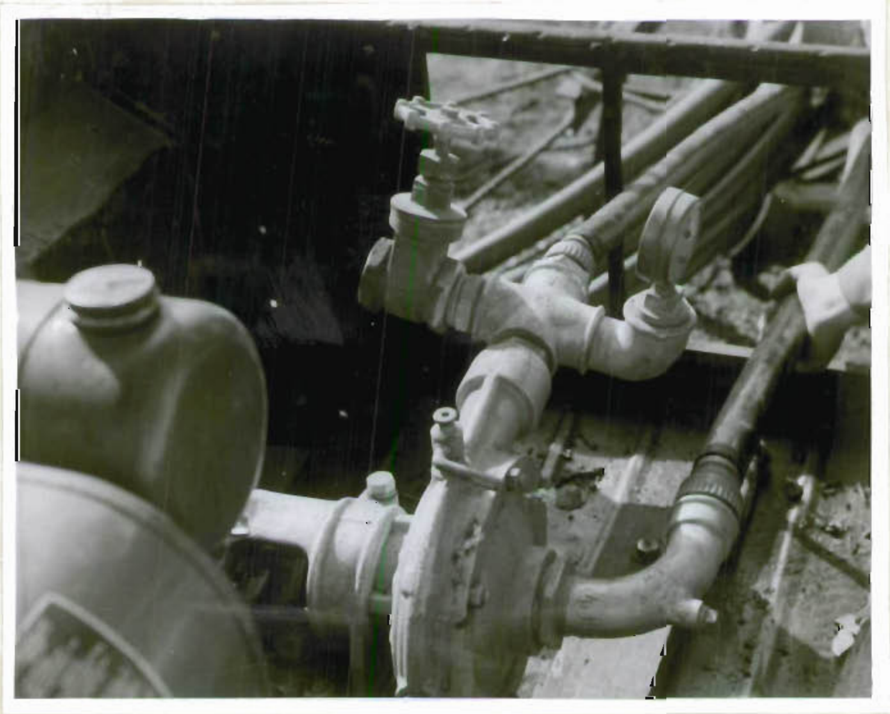


Plate X Aqua Jet centrifugal unit.

Plate XI Aquajet Venturi Type Pump.

Plate XII Trailer containing J.A.P. motor.

PUMPING TESTS

FIG. 1

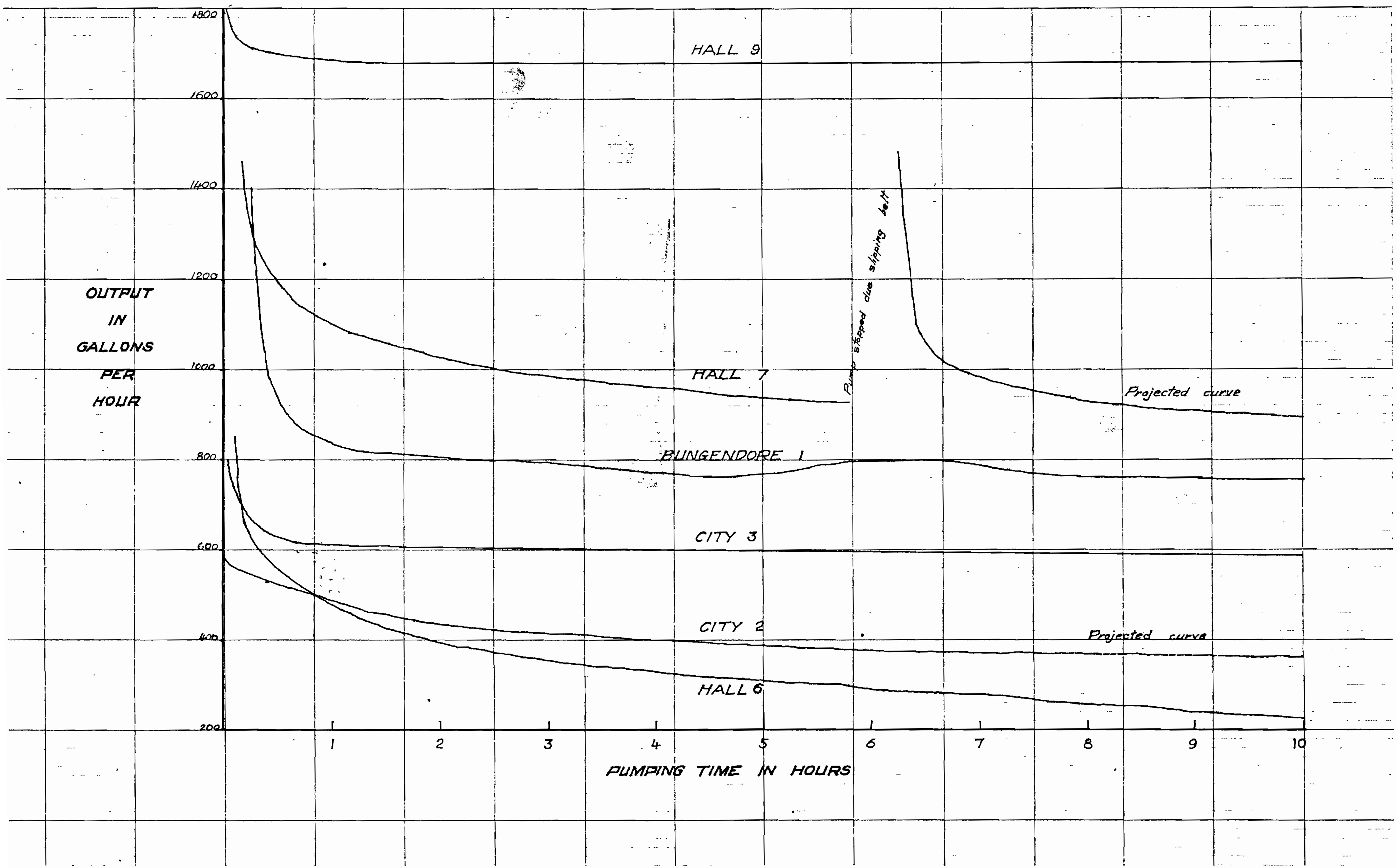


FIG. 2

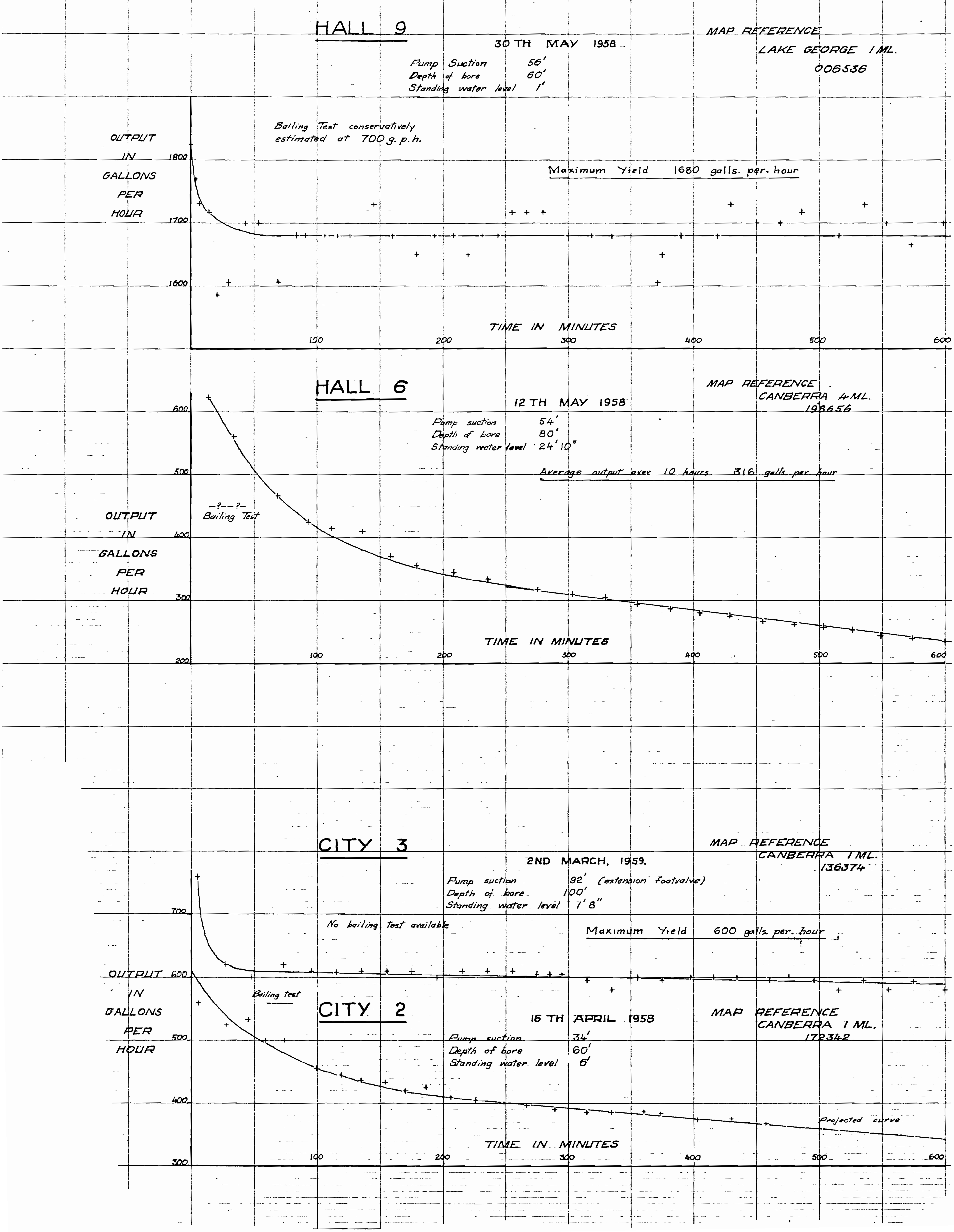
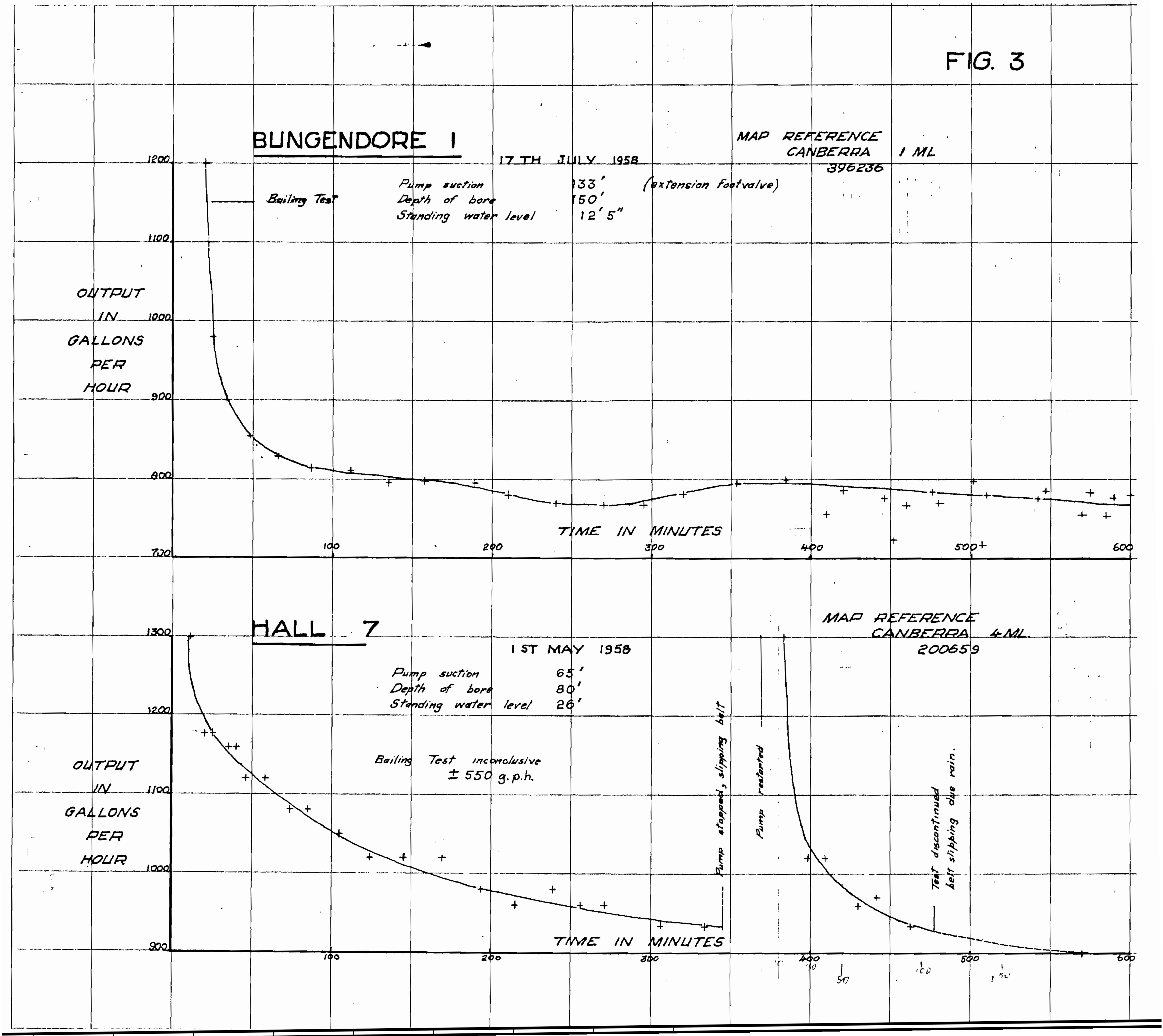
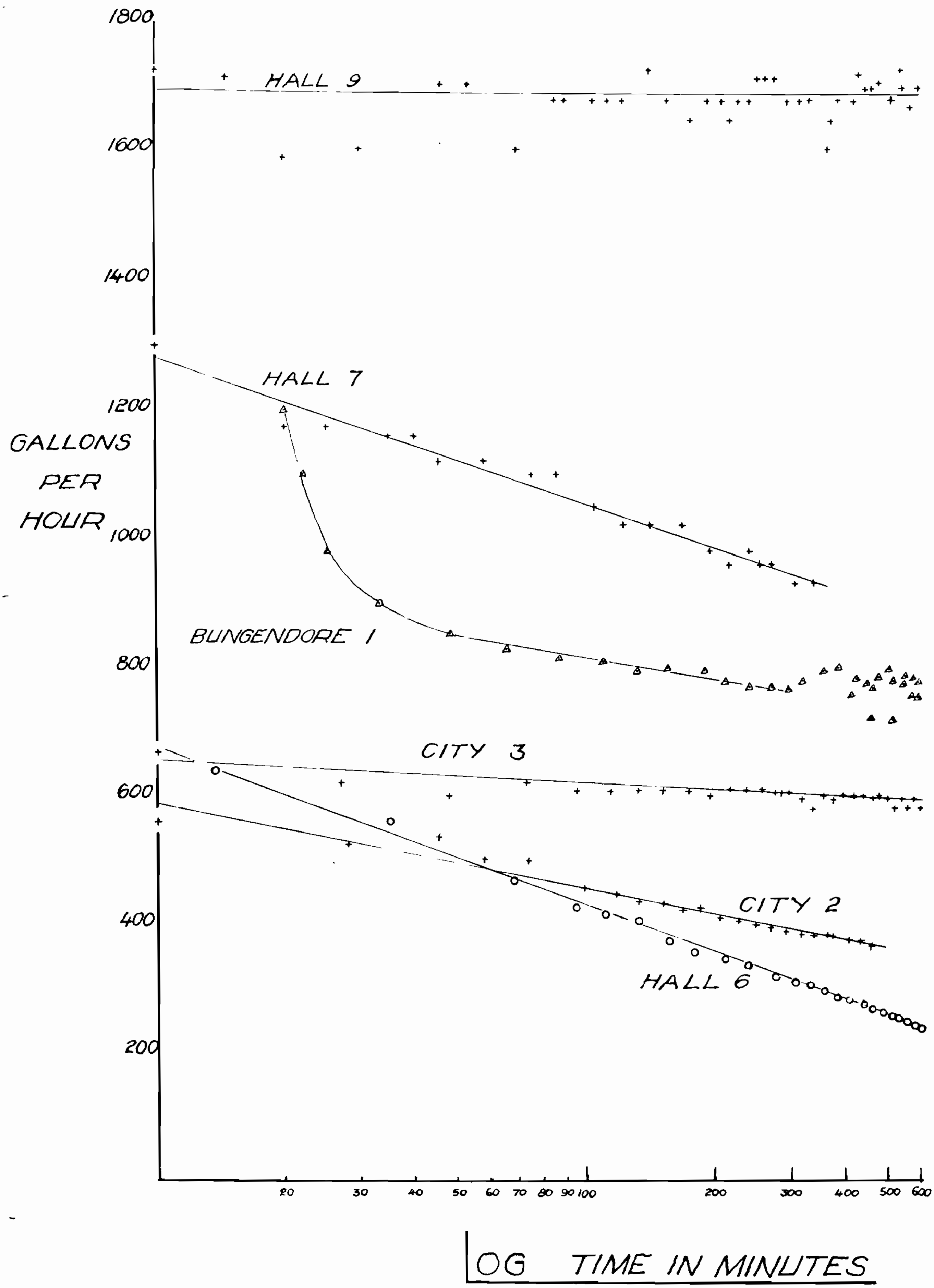

HALL 9
30 TH MAY 1958
Pump Suction 56'
Depth of bore 60'
Standing water level 1'
MAP REFERENCE
LAKE GEORGE 1 ML.
006536
Bailing Test conservatively estimated at 700 g. p. h.
OUTPUT IN GALLONS PER HOUR
1800
1700
1600
Maximum Yield 1680 galls. per. hour
TIME IN MINUTES
100
200
300
400
500
600
HALL 6
12 TH MAY 1958
MAP REFERENCE
CANBERRA 4 ML.
198656
Pump suction 54'
Depth of bore 80'
Standing water level 24' 10"
Average output over 10 hours 316 galls. per hour
600
500
400
300
200
-?--?-
Bailing Test
OUTPUT IN GALLONS PER HOUR
TIME IN MINUTES
100
200
300
400
500
600
CITY 3
2ND MARCH, 1959.
MAP REFERENCE
CANBERRA 1 ML.
136374
Pump suction 92' (extension footvalve)
Depth of bore 100'
Standing water level 1' 8"
No bailing test available
Maximum Yield 600 galls. per. hour
700
600
500
400
300
OUTPUT IN GALLONS PER HOUR
Bailing test
CITY 2
16 TH APRIL 1958
MAP REFERENCE
CANBERRA 1 ML.
172342
Pump suction 34'
Depth of bore 60'
Standing water level 6'
Projected curve
TIME IN MINUTES
100
200
300
400
500
600

FIG. 3



BUNGENDORE I
17 TH JULY 1958
MAP REFERENCE
CANBERRA 1 ML
396236
Bailing Test
Pump suction 133' (extension footvalve)
Depth of bore 150'
Standing water level 12' 5"
OUTPUT IN GALLONS PER HOUR
1200
1100
1000
900
800
700
TIME IN MINUTES
100
200
300
400
500
600
HALL 7
1 ST MAY 1958
MAP REFERENCE
CANBERRA 4 ML.
200659
Pump suction 65'
Depth of bore 80'
Standing water level 26'
Bailing Test inconclusive
± 550 g.p.h.
Pump stopped, slipping belt
Pump restarted
Test discontinued
belt slipping due rain.
OUTPUT IN GALLONS PER HOUR
1300
1200
1100
1000
900
TIME IN MINUTES
100
200
300
400
500
600

FIG IV


1800
1600
1400
1200
1000
800
600
400
200
GALLONS PER HOUR
HALL 9
HALL 7
BUNGENDORE 1
CITY 3
CITY 2
HALL 6
20
30
40
50
60
70
80
90
100
200
300
400
500
600
LOG TIME IN MINUTES