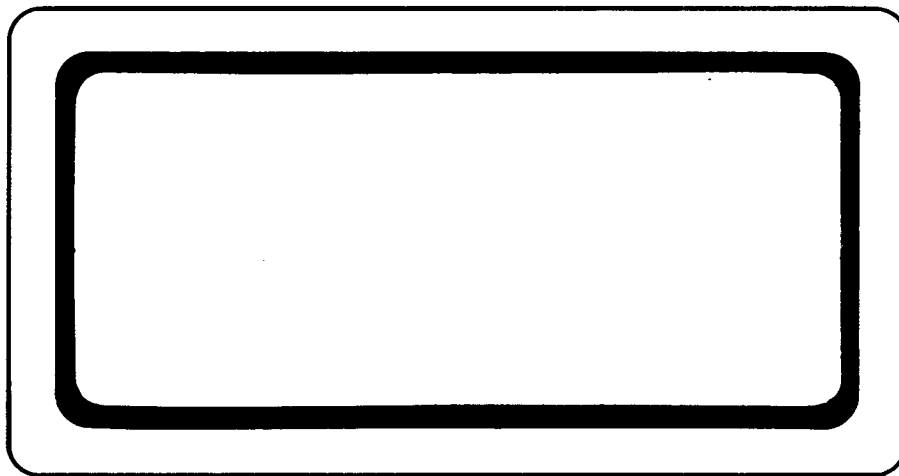




**Province of
British Columbia**

**Ministry of
Environment**

**WATER
MANAGEMENT
BRANCH**

AQUIFER TESTING AND
WATER WELL CONSTRUCTION PROJECT
FAIRVIEW HEIGHTS IRRIGATION DISTRICT

Ministry of the Environment
Victoria, British Columbia

June, 1977

ABSTRACT

Six wells were constructed at two sites for the Fairview Heights Irrigation District near Cawston, British Columbia. The wells were drilled using the cable-tool method and completed in a water-table aquifer. This aquifer, which occupies the Similkameen Valley, is at least 412 feet and perhaps as much as 1000 feet thick. Sand and gravel are predominant in the upper 125 feet of the aquifer. Discontinuous till sheets interbedded with sand and gravel occur below this. The shallow groundwater flow system is in hydraulic connection with the Similkameen River. Water-table fluctuations, which in part are dependant on Similkameen River stage, may be as much as 12 feet, although is expected to be in the order of 2-3 feet in the vicinity of the Irrigation District's wells. Groundwater is of the calcium-bicarbonate-sulphate type.

Four wells were completed in fine sands at site #1. Testing at this site showed the advantages of a natural well completion over that using an artificial sand pack. The three 16-inch production wells at this site were naturally completed and have a combined capacity in excess of 2600 USgpm. The specific capacities of these wells determined from 24-hour pumping tests, range from 42.0 to 45.6 USgpm/foot of drawdown. The 8-inch sand packed test well has a specific capacity of 6.5 USgpm/foot of drawdown and is now completed with an automatic water level recorder. A transmissivity of 3.3×10^5 USgpd/foot width and a storage of 0.1 were determined from pumping test data collected at this site.

Two production wells were completed in coarse sandy gravels at site #2. Testing at this site showed the improved well performance obtained by using a longer, larger diameter and more open well screen. The 8-inch well has a specific capacity of 137 USgpm/foot of drawdown and the 16-inch well (12-inch screen) a specific capacity of 210 USgpm/foot of drawdown. A transmissivity of 1.8×10^6 USgpd/foot width and a storage of 0.1 were determined from pumping tests. The combined capacity of these wells is 3100 USgpm.

The five production wells are capable of supplying the calculated demand of 5200 USgpm required by the Irrigation District.

TABLE OF CONTENTS

	<u>Page</u>
ABSTRACT	ii
TABLE OF CONTENTS.	iii
LIST OF FIGURES.	v
LIST OF TABLES	vi
LIST OF PHOTOS	vii
LIST OF APPENDICES	viii
1. INTRODUCTION	1
The Project.	1
Location	1
Climate.	1
Acknowledgements	4
2. GENERAL GEOLOGY.	4
Glacial Deposits	4
Non-Glacial Deposits	9
3. GENERAL HYDROGEOLOGY	12
Water Levels	12
Water Chemistry.	17
4. SITE HYDROGEOLOGY AND WELL FIELD DESIGN.	21
SITE #1.	21
Geology.	21
Well Design.	21
Test Hole #1	21
Test Hole #4	24
Test Hole #5	25
Test Hole #6	25
Pumping Tests.	26
Test Hole #1	26
Test Hole #4	27
Test Hole #5	34
Test Hole #6	35
Aquifer Analysis	36
Well Capacities.	38

TABLE OF CONTENTS (cont.d)

	<u>Page</u>
SITE #2.	42
Geology.	42
Well Design.	42
Test Hole #2	42
Test Hole #3	44
Pumping Tests.	45
Test Hole #2	45
Test Hole #3	45
Aquifer Analysis	46
Well Capacities.	47
5. WELL FIELD MANAGEMENT.	49
Water Level Monitoring	49
Pump Operation	51
Potential Problems	51
System Expansion	52
6. CONCLUSIONS.	53
7. RECOMMENDATIONS.	54
8. REFERENCES	55

LIST OF FIGURES

	<u>Page</u>
1. Location map	2
2. General stratigraphy	5
3. Cross-section of the Similkameen River Valley at Cawston (looking north).	10
4. Observation well location map.	14
5. Observation well hydrographs	15
6. Fairview Heights Irrigation District test hole #1 hydrograph	16
7. Water sample location map.	18
8. Plan - Site #1	22
9. Cross-section through site #1 (looking north).	23
10. Projected drawdown after 100 days pumping - Site #1.	40
11. Plan - Site #2	43

LIST OF TABLES

	<u>Page</u>
1. Chemistry analysis of water samples - Cawston area.	19
2. Pumping test #5 - well performance.	34
3. Pumping test #6 - well performance.	35
4. Pumping test #5 - aquifer analysis.	37
5. Pumping test #6 - aquifer analysis.	38
6. Theoretical well performance - site #1.	41
7. Pumping test #3 - well performance.	46
8. Pumping tests #2 and #3 - aquifer analysis.	47
9. Theoretical well performance - site #2.	48
10. Calculated drawdown at observation well #1, site #1	50
11. Calculated drawdown at Willis well - site #2.	50

LIST OF PHOTOS

	<u>Page</u>
1. View from Blind Creek looking west over Cawston Bench.	3
2. Remnants of a lateral till sheet behind Cawston Bench.	7
3. Sloping ice-marginal drainage features behind Cawston Bench.	8
4. Exposure of mud flow west of Keremeos.	11
5. Swabbing a 16-inch test production well - site #1.	29
6. View of well head during pumping test on well #4, site #1. . .	30
7. Automatic recorder installed on well #4, site #1 during pumping test #5.	31
8. Rossum sand tester - well #6 site #1	32
9. Oriface flow pipe registering a well yield of 1012 USgpm from well #6 site #1	33

LIST OF APPENDICES

- APPENDIX A Well and screen data - site #1
- APPENDIX B Pumping test data - site #1
- APPENDIX C Graphical analysis of pumping test data -
site #1
- APPENDIX D Observation well hydrographs from pumping
tests #5 and #6 - site #1
- APPENDIX E Well and screen data - site #2
- APPENDIX F Pumping test data - site #2
- APPENDIX G Graphical analysis of pumping test data -
site #2

FAIRVIEW HEIGHTS IRRIGATION DISTRICT
WATER WELL CONSTRUCTION PROJECT

1. INTRODUCTION

The Project

The original system supplying the Fairview Heights Irrigation District has been in operation since 1952 and utilized the Similkameen River as the water source. An investigation prepared by K. N. Pleasance (1975) in response to a written request from the District for assistance under the Agricultural and Rural Development Act (ARDA), recommended the construction of a new system based on a groundwater source of supply. Total water requirements were calculated as 5,200 USgpm.

This report covers the hydrogeological investigations, design, drilling and testing of one test well and five production wells completed under Water Investigations Branch, Groundwater Section, Contract #59. The well drilling contract was awarded to A. C. Drillers Ltd. of Keremeos in July and construction, using cable-tool equipment began on August 19, 1975. Final well testing was completed on February 24, 1976.

Location

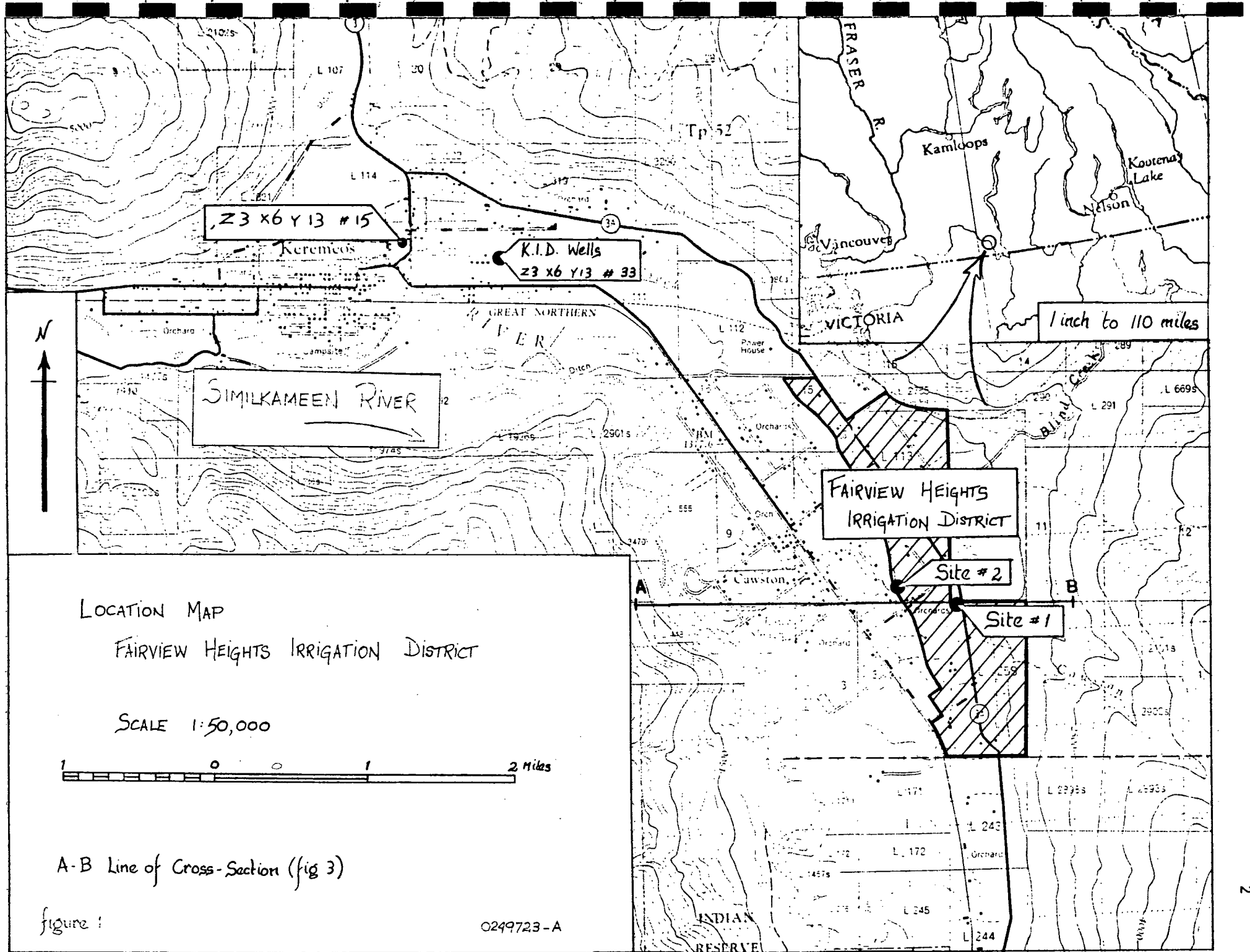
The Fairview Heights Irrigation District is situated on Cawston Bench, on the east side of Cawston Village in the Similkameen River valley some 4 miles southeast of Keremeos, British Columbia (figure 1, photo 1). The Similkameen River lies 1.5 miles to the west of the District.

The area is served by the Southern Trans-provincial Highway No. 3 which provides good access to other provincial centres and to the U.S.A.

Orcharding is the principal agricultural activity in the area.

Climate

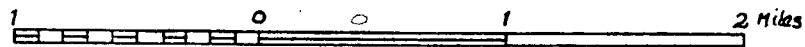
The Cawston-Keremeos area lies within the 'dry belt' of British Columbia receiving less than 10 inches of precipitation annually. The precipitation during the May to September period averages less than 5 inches.



LOCATION MAP

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE 1:50,000



A-B Line of Cross-Section (fig 3)

figure 1

0249723-A



Photo 1. View from Blind Creek looking west over Cawston Bench. The Indian Reservation (I.R. No. 6) is in the foreground and the Similkameen River flows southward (to the left) in the middle distance. Remnant ice-marginal terraces can be seen on the far slope. Orcharding is the principle agricultural activity on Cawston Bench. Note the locations of site #1 and site #2.

Temperatures average 10°C with recorded extremes of 41°C and -30°C . The average frost free period is of 160-180 days duration.

Acknowledgements

Credit for much of the success of this project goes to the well drilling contractors, Mr. Alex Laing and Mr. Gordon Monkman of A. C. Drillers Ltd. of Keremeos. The writer found the benefit of their experience and willing cooperation invaluable.

The assistance of Mr. Larry Gardner in changing the hydrograph chart on test hole #1 is gratefully acknowledged.

The assistance of the Groundwater Section staff in all phases of this program is gratefully acknowledged.

2. GENERAL GEOLOGY

The Similkameen River valley region is underlain by a variety of Paleozoic and Mesozoic metasediments, volcanics and intrusives. Tertiary basalts comprise some scattered outcrops. The bedrock, sculptured by Pleistocene ice activity, now forms the valley walls and surrounding high-land areas, standing as much as 5000 feet above the valley floor.

The valley is infilled with perhaps as much as 1000 feet of unconsolidated glacial and post-glacial materials. Recent geological history of the valley floor is dominated by fluvial aggradation and degradation, and on the steeper valley slopes, by the formation of mudflows and alluvial fans.

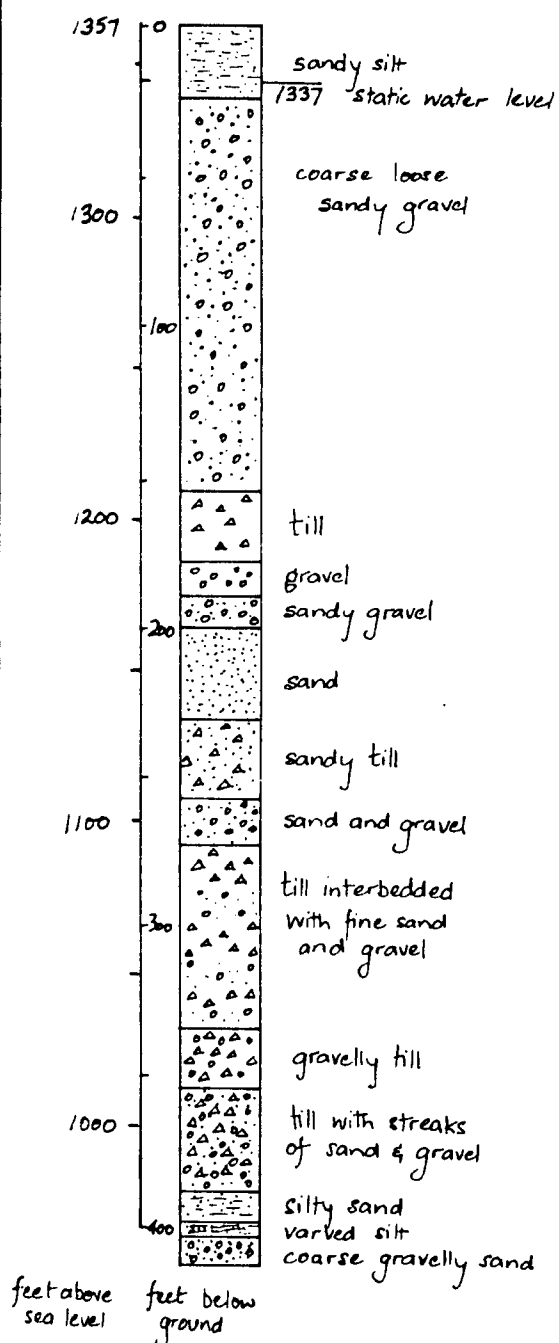
Glacial Deposits

Well records from the Similkameen Valley from Princeton to the U.S. border record the presence of discontinuous till layers. The deepest well (Z3 X6 Y13 #33) half a mile east of Keremeos, was drilled to a depth of 412 feet without reaching bedrock. The record from this well (figure 2) shows several layers of till, principally between 154 and 177 feet, 230 and 256 feet, and 272 to 388 feet below ground. The static water level is some 20 feet below ground. Two well records from Hedley also show the presence of more than one till. As at Keremeos, these tills are separated

GENERAL STRATIGRAPHY - FIGURE 2

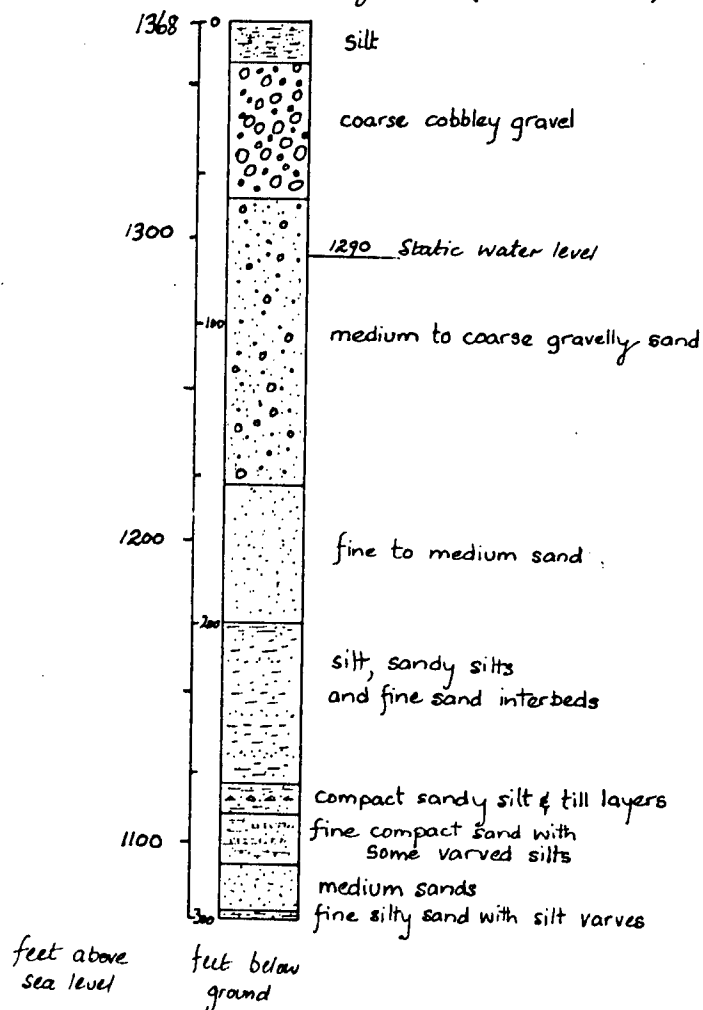
Z3 x6 Y13 #34

Keremeos Irrigation District



Z3 x7 Y4 #6

Fairview Heights I.D. (well #1 site #1)



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DWG. No. FIGURE 2

by sand and gravel. Ryder (1970) felt that there was insufficient evidence to suggest that these tills belong to more than one phase of glaciation, and thus are likely to represent minor fluctuations in the position of the ice front during final retreat of the ice.

Till is recorded in several of the more shallow wells. This till varies in thickness from zero to 53 feet (Z3, X6 Y13 #15) and occurs in the top 120 feet of sediment.

Problems of recognition by well drillers may in part explain the variable thickness and distribution of the till, but it is felt more likely that the till sheet was deposited on an irregular gravel surface, and further, that the till was eroded prior to subsequent gravel deposition (Ryder 1970).

This till is not seen in outcrop and is considered to be a basal till.

A remnant till sheet mantles part of the hillside behind Cawston (photo 2). This till is comprised of a white silty sandy matrix containing pebble to cobble-sized material. Ryder (1970) suggests that this till may be the source of the fine-grained material that was later incorporated as mudflow in alluvial fans.

The gullied surface of this till sheet leads Ryder (1970) to suggest that this till was once more extensive and its present form represents the final stage of erosion which began as gullying on the surface of the till sheet. Thus these tills (lateral tills) were quite extensive and probably continuous with the basal till recorded in well records.

Silts, fine sands and till? layers occur below 200 feet under the Cawston Bench and continue to a total drilled depth of 300 feet (see Appendix A test hole #1). These materials are probably of glacio-fluvial origin and derived from Blind Creek during the final retreat of the ice from the Similkameen Valley. Ryder (1970) describes small dissected benches that could possibly be the remnants of deltas built into a marginal lake occupying the Blind Creek valley by a stream draining through the col. Faint horizontal traces on the hillside south of Blind Creek could possibly

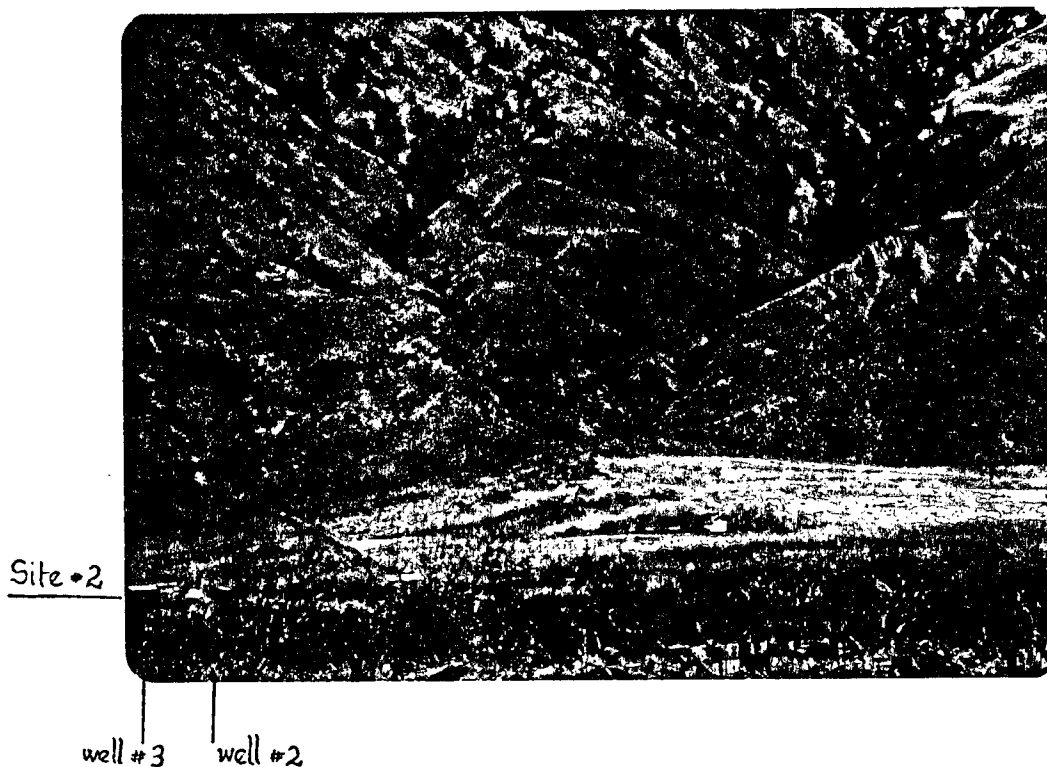


Photo 2. Remnants of a lateral till sheet behind Cawston Bench. Pronounced exposures are seen in creek embayments and on the bedrock slopes, faint lateral terraces. Note the completed production wells at site #2 on the edge of Cawston Bench and the storage tank for the new distribution system.

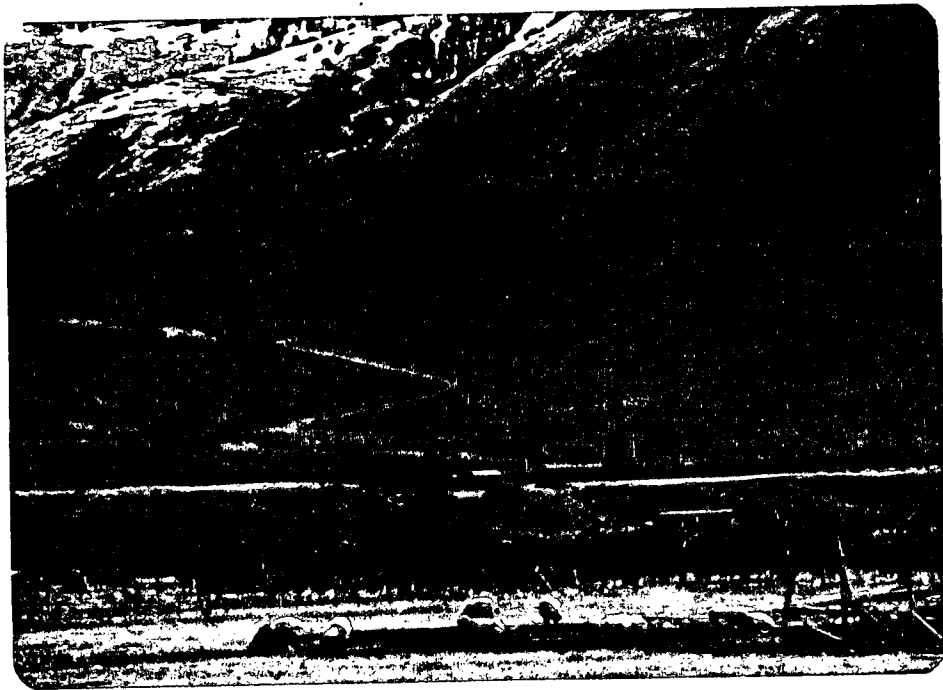


Photo 3. Sloping ice-marginal features behind Cawston Bench cut into the remnants of a lateral till sheet. The presence of these features indicates that perhaps Blind Creek was ice-free while ice still occupied the main Similkameen Valley.

represent the shorelines of this lake. Ryder (1970) observes that below 2000 feet, these horizontal traces are replaced by sloping ones (photo 3) which probably reflect ice marginal drainage conditions. These deltas, kame terraces and ice-marginal lakes could be the source of the fine sands and silts encountered below 200 feet under the Cawston Bench. The occurrence of medium and fine sands from 154-200 feet, which become more coarse going up, may be explained as ice-marginal deposits which upon retreat of the ice, were overlain by a sequence of sandy gravels.

Non-Glacial Deposits

Fluvial deposition followed upon the retreat of the ice sheet. The glacial drift is now buried by as much as 300 feet of fluvial and glacial-fluvial material in the Cawston Bench area, and by 10-30 feet in the Princeton area. These deposits are comprised dominantly of sandy gravels and locally, may contain significant amounts of generally fine sands and silts, (see cross section - figure 3).

A thin silty deposit blankets much of the Keremeos-Cawston area. This material is in the order of 5-15 feet thick and is perhaps derived by aeolian erosion of the silty lateral till sheet or aeolian winnowing from the coarser materials as gravel deposition declined. Ryder (1970) also suggests that a change in river characteristics leading to the deposition of finer material may account for this surficial silty layer.

Below this silt layer and down to the upper most till layer sandy gravels generally dominate. Under the Cawston Bench, sandy and cobbly gravels occur immediately below a surficial silty layer. These gravels gradually give way to sand, and below 154 feet medium and fine sands dominate. Below 200 feet the sequence consists of silts and fine sand interbeds which overlie compacted silt, sand and till layers at 259 feet.

Ryder (1970, 1971) describes in detail the alluvial fans in the Similkameen Valley. Generally these fans are mudflows (photo 4) that are in part comprised of "unusually massive beds" (Ryder 1971). Ryder's examination of the lithologies present in these flows, indicates the importance of contributions from the local bedrock, especially during

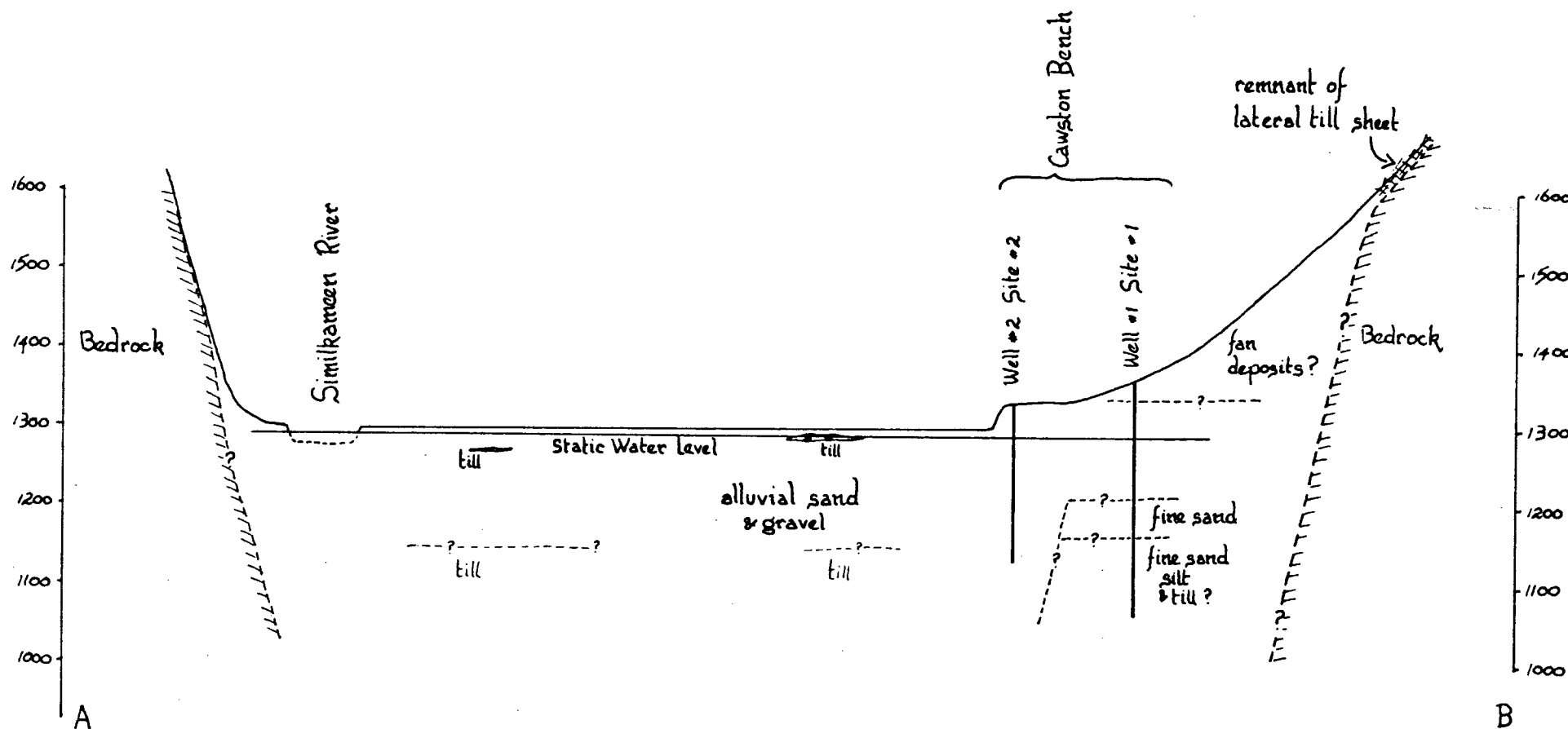


Figure 3 CROSS-SECTION OF THE
SIMILKAMEEN RIVER VALLEY AT CAWSTON

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SCALE: VERT. 1" = 200'

HOR. 1" = 25,000'

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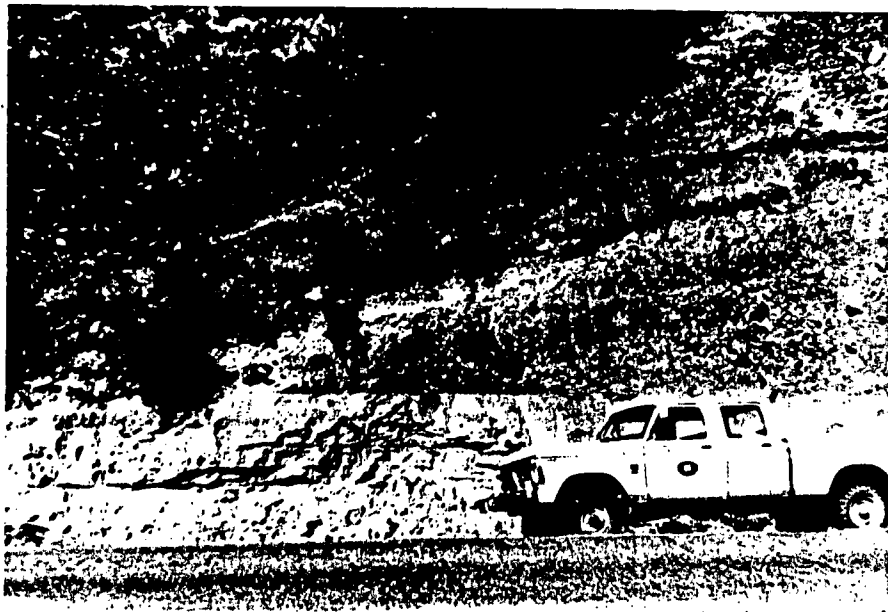


Photo 4. Exposure of a mud flow west of Keremeos is seen overlying alluvial silts which in turn overlie coarse sandy gravels. The fan consists of a very poorly sorted mixture of angular gravels and boulders embedded in a silty sandy matrix. An incomplete layer of Mazama volcanic ash occurs approximately 1 foot below the fan surface, indicating that most fan deposition took place prior to 6,600 years B.P.

the final stages of fan aggradation. Both the erratic material and the silt of the mudflow matrix probably originated from the dissection of a lateral till sheet which mantled the valley slopes. Remnants of this till sheet can be seen on the valley walls behind the Cawston Bench.

Included within these mudflow deposits is a layer of white volcanic ash (Mazama Ash) that has been dated as 6600 years B.P. Thus fan formation ceased after 6600 years B.P. and at present, small creeks are degrading into the surface of these fans.

3. GENERAL HYDROGEOLOGY

A continuous water-table aquifer occupies the Similkameen Valley from perhaps as far upstream as Princeton to beyond the U.S. border. Locally, the presence of semi-permeable silts and impermeable tills may result in semi-confined or confined aquifer conditions.

Sand and gravel comprise the main water-bearing zones in this aquifer which is known to exceed 412 feet in thickness (Z3 X6 Y13 #33) and may be as much as 1000 feet thick. In the Keremeos-Cawston area, the upper 150 feet consist dominantly of sands and gravels with lesser amounts of fine sands and silts and locally, the occasional thin till lens. It was shown during the construction and testing of wells for the Keremeos Irrigation District (1967) that the static water level and the piezometric level (from wells that were first completed below, and then above the till) were the same, indicating that the till sheet is discontinuous. Thus the unconsolidated materials (at least to a depth of 412 feet) can be considered as comprising one water table aquifer which contains discontinuous till sheets bounded above and below by permeable sands and gravels.

Water Levels

An examination of the non-pumping water levels recorded on drill logs shows that the water table elevation approximates that of the Similkameen River, thus suggesting that the shallow groundwater regime is hydraulically connected to the river. The elevation of the Similkameen

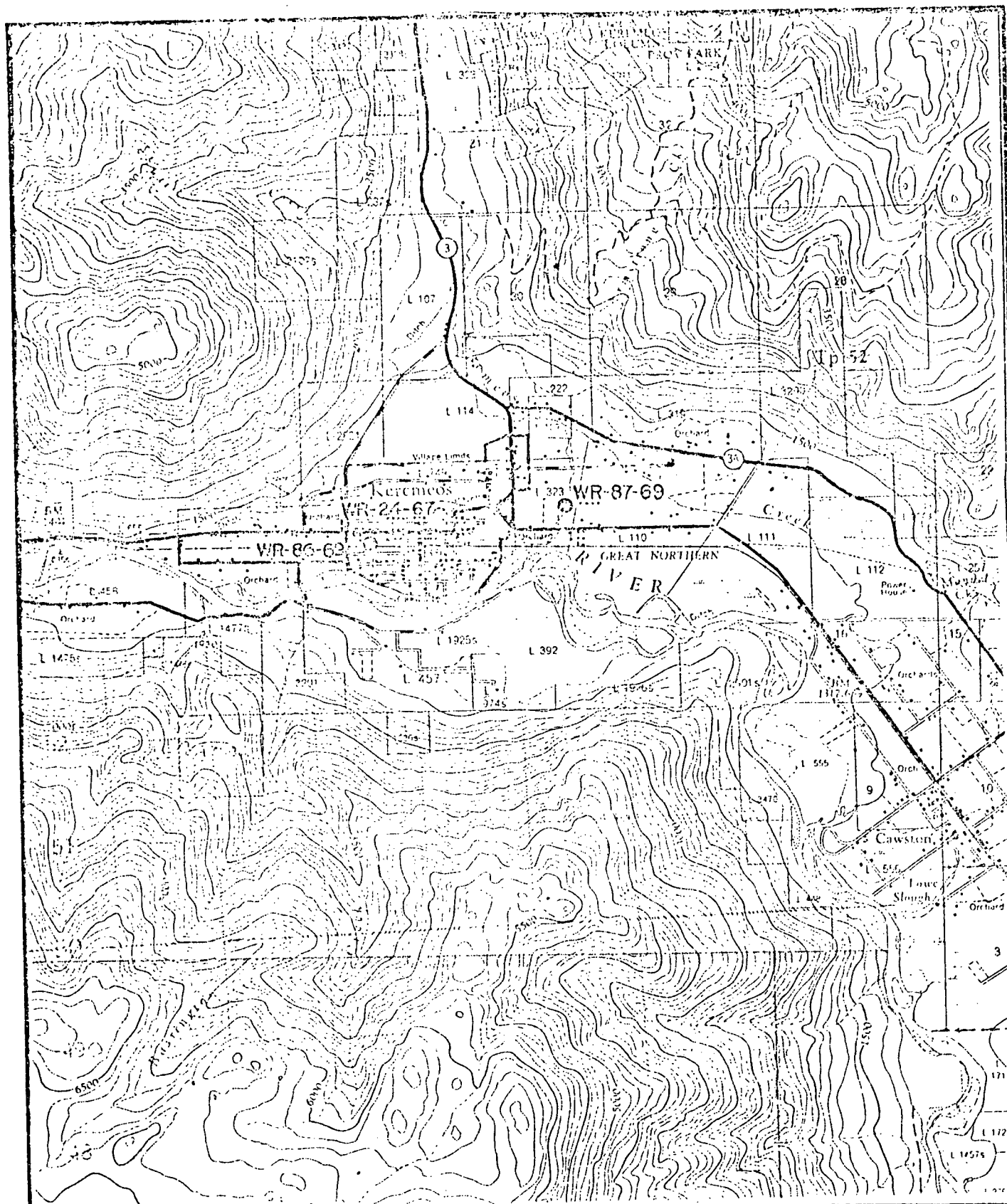
River at Princeton is 2100 feet (above mean sea level) and 1460 feet at its confluence with the Ashnola River. The average gradient for this section of the river is $\frac{640 \text{ feet}}{32.5 \text{ miles}} = 19.7 \text{ feet/mile}$. The gradient in

the Keremeos-Cawston area is approximately 14 feet/mile and between Cawston and the U.S. Border is approximately 9 feet/mile.

In cross section the water-table profile is not known but is expected to be essentially horizontal, except where influenced by underflow or recharge from the adjacent valley walls. River stage will have a controlling influence on the magnitude and direction of the water-table gradient (in a cross-section profile). At low river stage, the water table may slope towards the river and recharge from groundwater is expected. At high river stage the reverse situation is expected. Locally, this situation is masked by the effect of varying aquifer permeabilities and the incidence of extraction points (producing wells), which may cause local cones of depression.

Historical records showing the fluctuation of the water table are recorded from three observation wells in the Keremeos area, (figure 4), (WR 24-67, WR 86-69, WR 87-69). These wells vary in depth from 92 to 199 feet below ground and are completed in the upper permeable sands and gravels that overlie the till sheets. These wells are read manually at the middle and end of the month and records exist from 1967 to present for WR-24-67 and from 1969 to present for the other two wells (figure 5). Seasonal fluctuations are in the order of 3 to 7 feet with maximum fluctuations in the order of 12 feet. The magnitude of these fluctuations are about one-third to one-half those of the Similkameen River stage recorded near Nighthawk on the U.S. border (figure 5).

An automatic water level recorder was installed on test hole #1 (Z3 X7 Y4 #6) drilled for the Fairview Heights Irrigation District. The water level fluctuations at this point since December 1975 has been less than 2.0 feet. This hydrograph (figure 5) shows the delayed response of as much as 2 months between the river peak and the water table peak.



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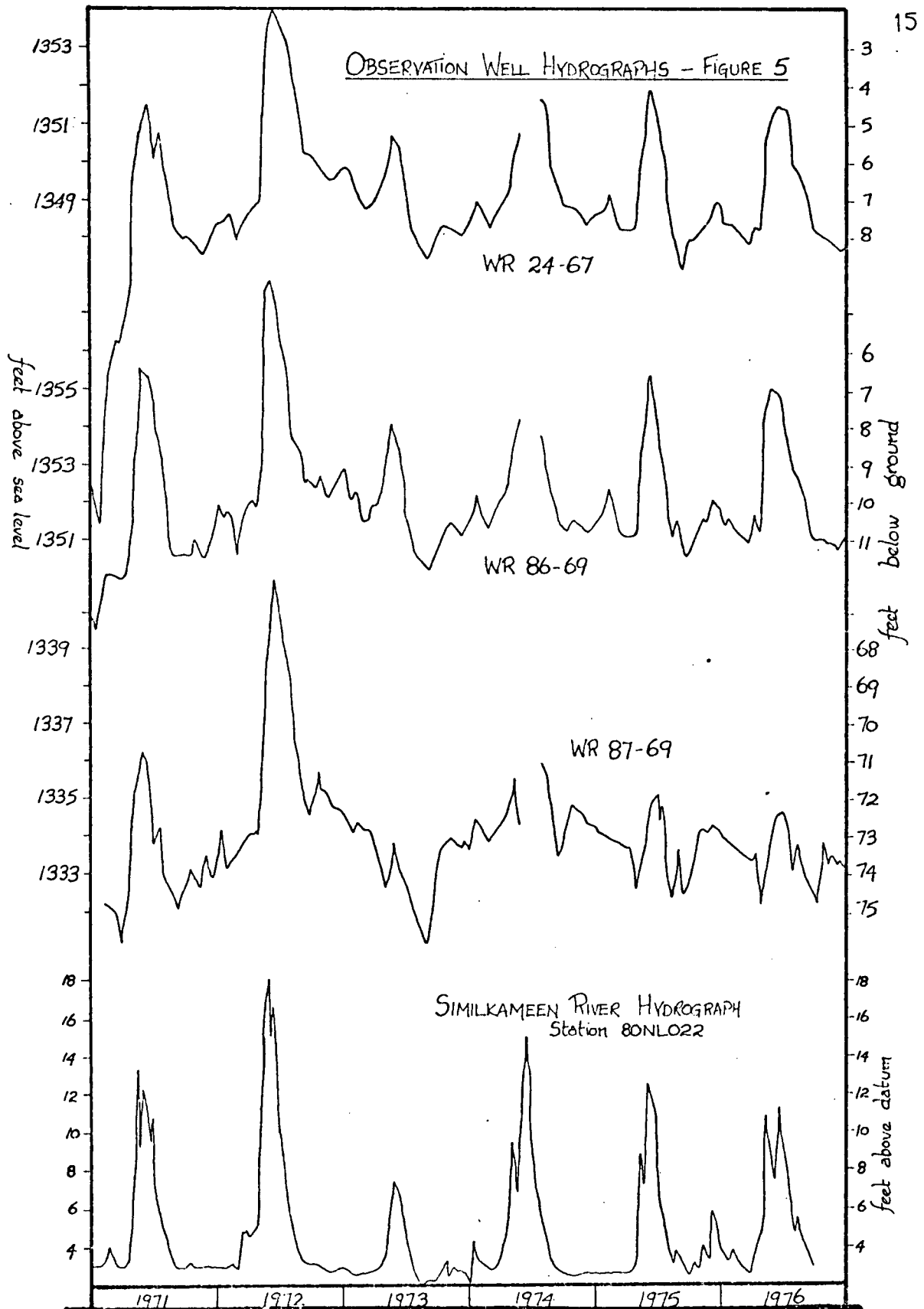
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1.25 inch = mile Approx.

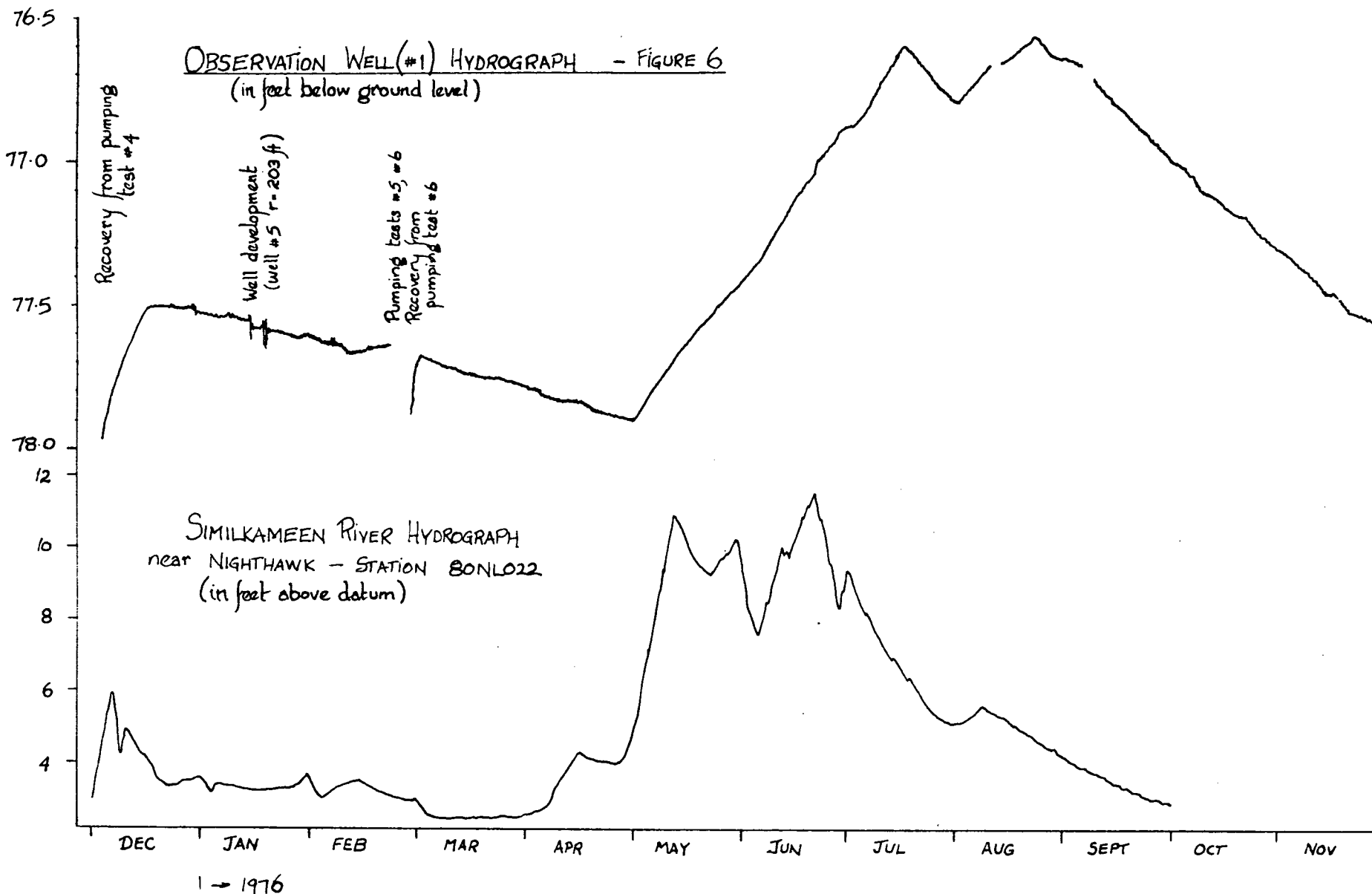
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OKANAGAN-SIMILKAMEEN WATERSHED
OBSERVATION WELL LOCATION

KEREMEOS FIGURE 4



BRITISH COLUMBIA DEPARTMENT OF ENVIRONMENT WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH		TO ACCOMPANY REPORT ON FAIRVIEW HEIGHTS IRRIGATION DISTRICT	
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J. M. PETRIE

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DWG. No. FIGURE 6

Analysis of pumping test data from the Keremeos Irrigation District wells showed that the transmissivity of the sands and gravels is in the order of 2×10^6 USgpd/ft. The gradient of the water table in the area of Keremeos is in the order of 14 feet/mile. Using Darcy's Law:

$Q = T.I.W.$ (Where T is the coefficient of transmissivity, I is the hydraulic gradient and W is the width of the vertical section through which the flow occurs).

$$Q = 2.0 \times 10^6 \text{ USgpd} \times 14 \text{ ft/mile} \times 1.5 \text{ miles} \\ = 42,000,000 \text{ USgpd or } (x.000001548) = 65 \text{ cfs.}$$

Thus in the area of Keremeos some 65 cfs of groundwater is moving down valley.

At Cawston, the hydraulic gradient is the same.

$Q = T.I.W.$ (T is averaged as testing shows a value of 3.3×10^5 in sands 1.8×10^6 in gravels)

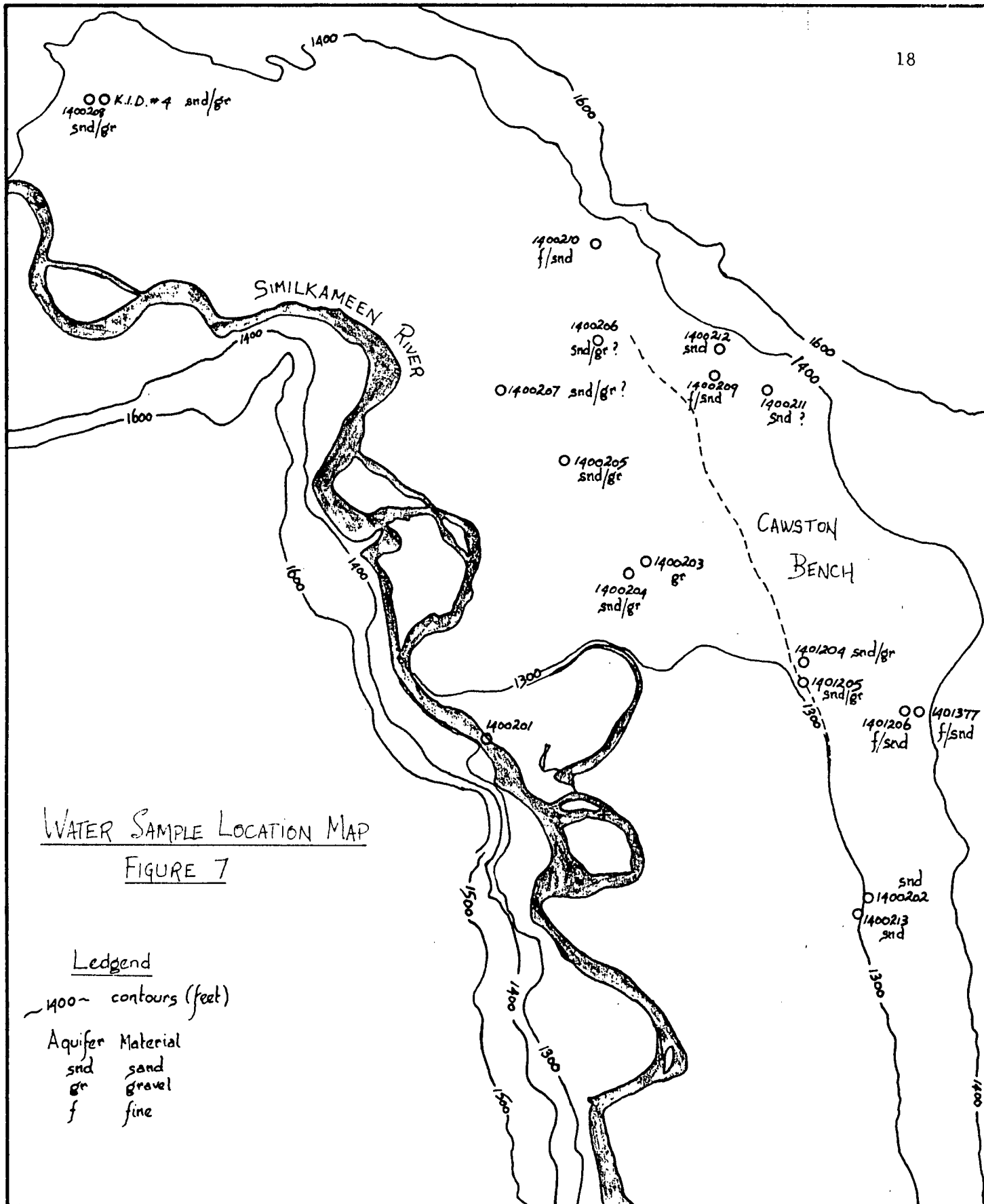
$$Q = 9.8 \times 10^5 \text{ USgpd/ft} \times 14 \text{ feet/mile} \times 2 \text{ miles} \\ = 27,440,000 \text{ USgpd } (x .000001548) = 42.5 \text{ cfs}$$

These calculations show that a considerable volume of groundwater is moving down valley, and will contribute significantly to the river at times of low surface flow.

Water Chemistry

Water samples were collected from the Cawston area as part of the initial hydrogeologic investigation of the area. These analysis, and others taken from completed production wells are listed on table 1. Sample locations are plotted on figure 7. The groundwater of the area can be described as calcium-bicarbonate-sulphate type water.

Carbonate hardness ranges from 164 to 424 ppm (parts per million) with one exception. Sample 1401377 was taken from inside the well casing, not the screen, some 10 months after this group of wells were last pumped, and the analysis shows a hardness of 58.6 ppm which is lower than that of the Similkameen River (76 ppm - 1400201) and significantly lower than other samples collected in the area. The excessively high iron (16.7 ppm)



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HOR 1:31,680 or inch to 2 mile

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FILE No. 0249723 - A

DWG. No. FIGURE 7

TABLE 1
CHEMICAL ANALYSIS OF WATER SAMPLES - CAWSTON AREA

SITE I.D.	OWNER	WELL NO.	DATE SAMPLED	pH	Specific Conductivity (micromhos/cm)	TDS	Ca ²⁺	Mg ²⁺	Na ⁺	K ⁺	SO ₄ ²⁻	Cl ⁻	Total Iron	Total Manganese	Total Phosphorus	Total Nitrogen	Total Alkalinity	Total Hardness as CaCO ₃
1400202	Erikson	Z2 X7 Y33 #8	6 May 75	7.5	740	520	93.4	34.0	16.1	5.4	163	2.2	0.2	0.02	0.004	0.815	237	370
1400203	Barber	Z3 X7 Y5 #45	6 May 75	7.6	395	250	58.4	9.2	8.3	1.9	44.9	1.4	0.1	0.02	0.008	0.635	153	181
1400204	Jenner	Z3 X7 Y5 #25	6 May 75	7.5	388	246	58.8	9.3	8.7	1.9	46.8	1.4	0.1	0.02	0.007	0.555	155	184
1400205	Harker	Z3 X7 Y8 #33	6 May 75	7.4	360	232	52.2	9.3	8.0	2.0	46.8	1.9	0.8	0.03	0.006	0.825	136	167
1400206	Mahoney	Z3 X7 Y8 #34	6 May 75	7.5	441	286	65.4	10.4	11.2	2.0	59.8	1.6	0.1	0.02	0.008	1.095	166	205
1400207	Klettke	Z3 X7 Y7 #10	6 May 75	7.3	354	226	51.6	8.9	8.5	1.9	42.2	1.4	0.1	0.02	0.005	0.515	138	164
1400209	Ritchie	Z3 X7 Y8 #22	6 May 75	7.5	729	516	104	18.4	31.9	2.3	148	3.2	0.7	0.04	0.053	2.638	243	335
1400210	Ritchie	Z3 X7 Y8 #26	6 May 75	7.9	822	608	120	25.5	24.0	2.9	250	7.5	1.3	0.13	0.018	0.055	192	405
1400211	Mason	Z3 X7 Y9 #2	6 May 75	8.0	595	398	73.6	21.0	25.1	1.1	94.4	2.2	0.1	0.02	0.019	1.597	225	270
1400212	Schwetje	Z3 X7 Y9 #1	6 May 75	7.8	575	412	67.6	20.6	30.2	1.3	96.8	2.6	0.1	0.02	0.017	1.865	211	253
1400213	Ricker	Z2 X7 Y33 #7	6 May 75	7.8	758	560	100	33.5	22.3	5.2	184	3.0	0.2	0.02	0.005	1.215	245	328
1401204	Fairview Heights I.D. #3	Z3 X7 Y4 #8	26 November 75	7.8	799	568	122	18.6	20	2.7	216	5.5	0.2	0.22	0.008	1.32	204	381
1401205	Willis	Z3 X7 Y4 #12	27 November 75	7.5	880	632	132	23	26.8	3.1	244	4.4	0.1	0.02	0.007	3.86	230	424
1401206	Fairview Heights I.D. #4	Z3 X7 Y4 #9	28 November 75	7.6	540	354	70.0	23.5	4.9	4.8	89.7	0.8	0.1	0.02	0.003	0.08	206	272
1401377	Fairview Heights I.D. #1	Z3 X7 Y4 #6	3 October 76	8.3	130	80	14.9	5.2	3.6	2.0	15.5	1.0	16.7	0.24	0.003	0.41	51.6	58.6
K.I.D. #4	Kereheos I.D. #4	Z3 X6 Y13 #32	2 November 67	7.9	395	248						1.0	0.03			2	166	222
1400208	Kereheos I.D. #5	Z3 X6 Y13 #34	6 May 75	7.6	499	328	74.0	13.2	11.4	2.5	58.9	2.1	0.1	0.02	0.009	2.115	196	239
1400201	Similkameen R. at Cawston		6 May 75	8.0	167	104	23.6	4.3	3.6	0.8	12.2	1.1	0.4	0.04	0.005	0.125	70.5	76

Note: All values in parts per million (ppm) except pH and specific conductivity.

is also not representative, thus this analysis (1401377) is dismissed from the following discussion.

Sulphate values range from 42.2 to 244 ppm and calcium ranges from 51.6 to a high of 132 ppm. The specific conductivity, which is a reflection of the amount of dissolved mineral matter in the water, shows high values ranging from 354 to 880 ppm. Groundwater flow systems originating on the adjacent valley slopes can be called upon to explain the presence of the mineral content of the waters. An examination of figure 7 showing the sample locations demonstrates that those wells completed in less permeable aquifer materials (i.e. fine sand) and close to the valley wall contain the more mineralized groundwaters.

Sample 1400201 was collected from the Similkameen River near the Fairview Heights Irrigation District pumphouse at Cawston. Groundwater recharge to the river and extensive mining operations upstream, can probably explain in part the hardness and calcium values of this river water.

It is interesting to note the values for specific conductivity and hardness in sample K.I.D. #4 taken in 1967. This production well is situated in the well field of the east site of the Keremeos Irrigation District. Since 1967, these four wells have intermittently pumped 1000 USgpm. A sample (1400208) taken from one of these wells (150' west of K.I.D. #4) showed no significant change in water quality. It was originally suspected that long-term pumping from wells completed in this water table aquifer would result in an improvement of the water quality as river water was induced into the aquifer.

Nitrate concentrations show considerable variation - ranging from 0.02 to 3.7 ppm. It is realistic to suspect that this nitrate concentration is a reflection of local conditions i.e., proximity to an effluent disposal point or the result of fertilizer applications, rather than regional hydrogeologic conditions.

The water quality in the area of the Cawston bench poses some potential problems for the Fairview Heights Irrigation District's wells. These problems are discussed in a later section on well field management.

4. SITE HYDROGEOLOGY AND WELL FIELD DESIGN

SITE #1

Wells #1, #4, #5 and #6 were drilled on site #1 located immediately south of the Indian Reservation (I.R. No. 6) and west of Barcello Road (figures 1 and 8).

Geology

The geology at site #1 consists of a sequence of medium and then fine sands, giving way below 200 feet to silts and fine sands. Test drilling at this site showed that these silts and fine sands continued to a depth of 300 feet. Towards the west, i.e., progressing from TH #1 to TH #6 the fine sands become slightly more coarse as do the overlying medium sands. A general log of this sequence (obtained from test hole #1) is outlined below:

0 - 13	silt and some fine sand
13 - 61	coarse cobbly gravel
61 - 154	medium sand with occasional pebbles and gravel
154 - 200	fine sand
200 - 300	silts and fine sand

(For complete log and construction details, see Appendix A.)

The water table lies some 80 feet below ground at an elevation of 1290.0 feet A.S.L.

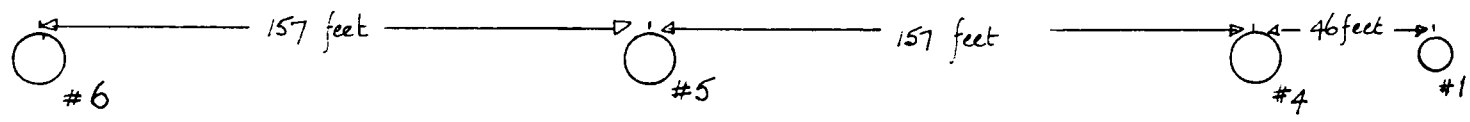
Well Design

Test hole #1 is 8 inches in diameter and located at the eastern end of site #1 (figures 8 and 9). It was anticipated that because of the fine sands encountered, it may not be feasible to construct a natural packed production well in the aquifer because of the limited screen intake area available. A representative sieve analysis curve (Appendix A) shows that 70% of the aquifer material would be retained by an 8-slot screen. As described by Johnson (1975), the required sand pack should plot on a curve with the 70% retained equal to 8-slot x 4 = 32 slot.

LOT
37

I.R. N°6
BLIND CREEK

Highway
(BARCELLO RD)



LOT 38

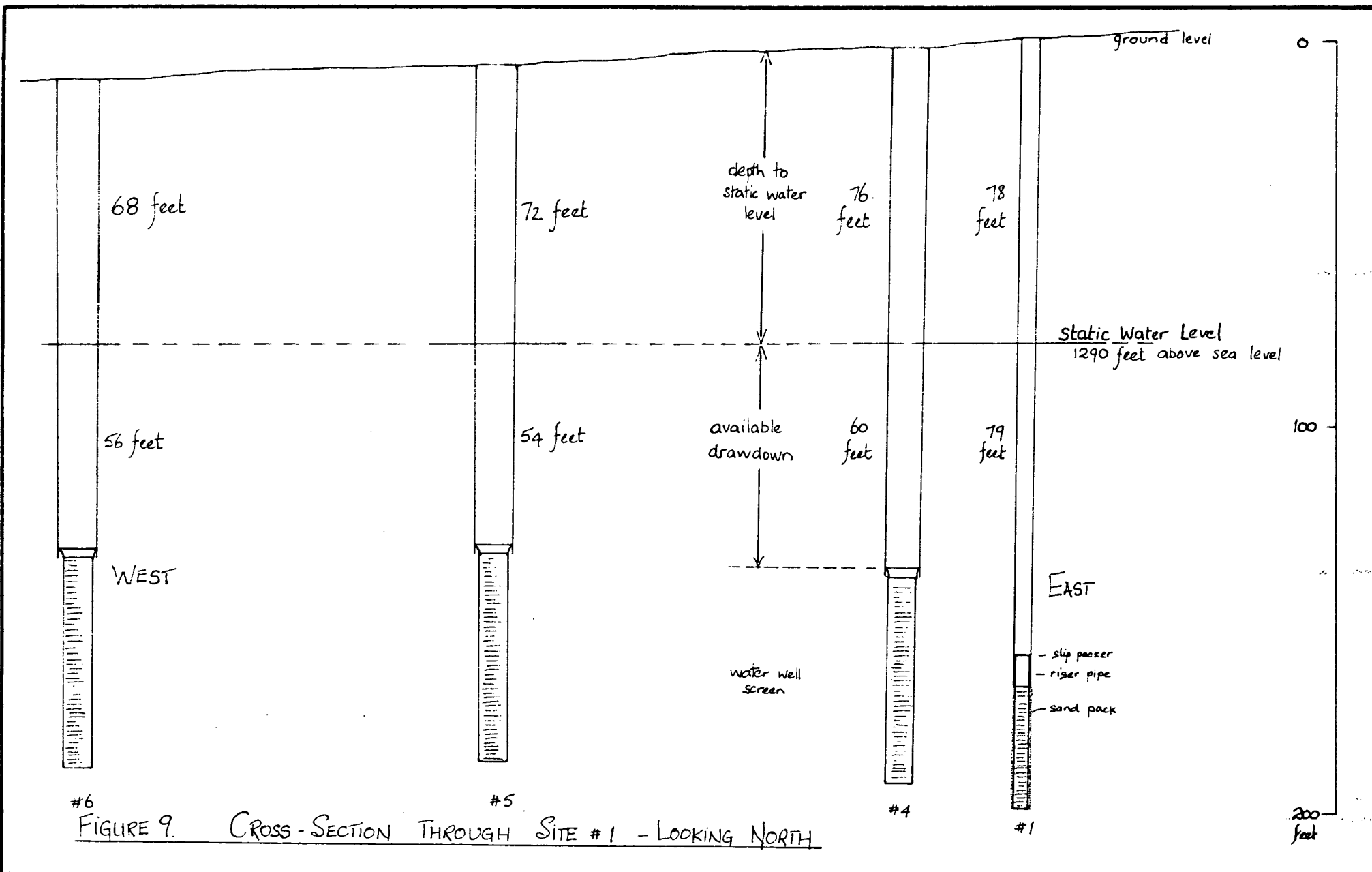


FIGURE 8 . PLAN - SITE #1
BOUNDARY OF IRRIGATION DISTRICT ---

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WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.	DATE
HOR. 1 cm = 20 feet	22
J. M. PETRIE	ENGINEER
FILE No. 0249723 - A	DWG. No. FIGURE 8



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WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT. 1" = approx 33 feet

HOR.

J. M. PETRIE

DATE

23

ENGINEER

FILE No. 0249723 A DWG. No. FIGURE 9

Material of this size was not available so f-16 Monterey filter sand with a 70% retained equal to 25-slot was used. A 6-inch nominal 30-slot Johnson stainless steel well screen was installed between 169-199 feet and topped off with a 10-foot riser pipe and slip packer. Fifteen bags of f-16 Monterey filter sand were used for the sand pack. The well was developed by bailing and then some gentle surging. Slight amounts of sand pack, aquifer sand and silt were moved during development. The static water level was 78 feet below ground level. A pumping test on this well showed it to have a specific capacity after 24 hours of pumping of 6.5 USgpm/ft. A well efficiency of 5% was calculated. Both these values were much lower than anticipated.

Test hole #4 is a 16-inch test production well drilled 46 feet to the west of test hole #1. This hole was drilled to a depth of 204 feet and encountered similar materials as in test hole #1 (see Appendix A for complete log and construction details). As an alternative to the sand pack design, a long length of screen was used for a natural well completion. The screen design table (see Appendix A) shows that the sand is fine and medium sized. The static water level was 76 feet below ground. The following screen was designed and installed in the well:

Slot Size	Depth (ft.)	Length (ft.)	% of Aquifer Retained Behind Screen
30	138 - 153	15	35
20	153 - 156	3	30
15	156 - 188	32	20-30

The screen is a 50-foot length of 12-inch nominal Johnsons stainless steel water well screen, and has a designed transmitting capacity of 1,195 USgpm at an entrance velocity of 0.1 ft/sec. The low retention allowed the use of a more open screen, which, in the experience of the drillers, Mr. Alex Laing and Mr. Gordon Monkman, led to a much improved well performance. The screen was set high (138 feet) to utilize as much of the more coarse material as possible. It was hoped that the decrease in available drawdown would be more than offset by an improvement in the specific capacity. A pumping test showed

that this was the case. The specific capacity was 44.5 USgpm/ft. and efficiency was improved to approximately 20%. Thus, it was considered feasible to construct two more natural pack 16-inch test production wells on site #1.

Test hole #5 is a 16-inch production well located 157 feet to the west of test hole #4. This hole was drilled to a depth of 196 feet and penetrated a similar sequence of unconsolidated sediments as those encountered in test holes #4 and #1 (see Appendix A for complete log and construction details). The following screen was designed, based upon an examination of the sieve analysis of the aquifer material:

<u>Slot Size</u>	<u>Depth (ft.)</u>	<u>Length (ft.)</u>	<u>% Retention</u>
20	128 - 131	3	82
30	131 - 137	6	20-50
20	137 - 146	9	25-40
15	146 - 171	25	25-30
15	171 - 178	7	50

This is a 50-foot long, 12-inch nominal water well screen with a designed transmitting capacity of 1,132 USgpm at an entrance velocity of 0.1 ft./sec. The screen was designed to utilize as much of the more coarse material as possible and again a very open screen was used. The high percent retention of the uppermost and lowermost section of the screen was necessary to prevent the overlying more fine material from entering the well during development and subsequent pumping.

Initial development by bailing showed the well to have a good specific capacity. Very little fine sand was moved. Surging in the casing also moved little sand. Swabbing moved a lot of silt and fine sand (Photo 5). After a further three days of swabbing, only minor amounts of fine sand and silt were being moved. The static water level is 72 feet below ground. A specific capacity of 42.0 USgpm/ft., an efficiency of approximately 20% and a transmissivity of 3.2×10^5 USgpd/ft. were determined from a 24-hour pumping test.

Test hole #6 is a 16-inch production well located 157 feet to the west of test hole #5. The well was drilled to a depth of 204 feet and

encountered similar, but slightly more coarse, sediments as those recorded in the three adjacent test holes. The following screen design was based upon examination of the sieve analysis of the aquifer material (see screen design table, Appendix A):

<u>Slot Size</u>	<u>Depth (ft.)</u>	<u>Length (ft.)</u>	<u>% Retention</u>
30	126 - 130	4	30-40
40	130 - 141	11	30-45
20	141 - 156	15	20-25
20	156 - 171	15	30-50
20	171 - 176	5	20

This is a 50-foot length of 12-inch nominal water well screen with a designed transmitting capacity of 1,443 USgpm at an entrance velocity of 0.1 ft./sec.

The well bailed easily during initial development. Surging moved a lot of fine sand into the well which then started to clear up. Swabbing initially moved much fine sand and silt into the well, but this condition cleared. A total of 10 days however was required for well development. The static water level was 68 feet below ground level. After a pumping test of 24 hours' duration, the specific capacity was 45.6 USgpm/ft. and well efficiency was in the order of 20%.

Pumping Tests

Test hole #1 was step tested at rates of 165, 216, and 305 USgpm (see Appendix B and C for pumping data and graphical solution of aquifer parameters). The average pumping rate was 300 USgpm. The well yield was measured with a flow meter which, after completion of the test, was found to be incorrectly calibrated. The test was rerun and the flow meter checked against an orifice flow pipe and was found to read too high by a factor of 60%. The above flow rates are the corrected rates. After 24 hours of pumping the specific capacity was 6.7 USgpm/ft. The change in pumping rate during the test produced no significant change in the specific capacity. Toward the end of the pumping test, the water level in the well was rising (see plot of drawdown data - Appendix C). This is probably a reflection of continued well development during pumping, leading to a marginally more efficient well.

The well produced negligible amounts of sand during testing and thus, the sand pack completion is satisfactory in terms of preventing the passage of aquifer material into the well. When the pump was shut off, the water level rebounded instantly to above the original static, settled out and then slowly recovered. This response indicates a high aquifer transmissivity and a low well efficiency.

The pumping water level data shows considerable variations because of fluctuating gasoline engine performance. Aquifer transmissivity is calculated from the drawdown data as 5.2×10^4 USgpd/ft. and from the recovery data as 3.68×10^5 USgpd/ft. Approximate well efficiency is determined by multiplying the specific capacity by 1,500, and dividing by the T value:

$$\begin{aligned} 6.7 \times 1,500 &= 10,050 \text{ (approximate T value)} \\ 10,050 / 3.68 \times 10^5 &= 2.73\% \text{ efficient} \end{aligned}$$

The very low efficiency and specific capacity, combined with a high aquifer transmissivity, demonstrated that a sand pack completion was not practical for construction of high capacity production wells. A natural completion was considered for the next well (test hole #4) drilled at this site (site #1).

Test hole #4 was pumped at 728 USgpm for 40 minutes and at 812 USgpm for a further 1,185 minutes. The pumping rate was then being increased when the discharge line parted and the pump was shut off. An orifice pipe and flow meter were used to determine well yield during this test (photo 6). The water level in test hole #1, 46 feet to the east, was recorded manually during this test. After 1,225 minutes of pumping, well #4 had drawn down 18.26 feet for a specific capacity of $812 / 18.26 = 44.5$ USgpm/ft. At the same point in time, the drawdown in well #1 was 2.57 feet (Appendices B and C). The drawdown plot for each well is irregular because of slight variations in engine speed. A straight-line plot of the drawdown shows an aquifer transmissivity of 3.35×10^5 USgpd/ft. for the pumped well and 3.5×10^5 USgpd/ft. for the observation well (#1). Data for the initial 100 minutes shows a much higher T value - in the order of

10^6 USgpd/ft. This is very high and thought not to be representative of the aquifer. Analysis of the recovery data showed a T value of 2.65×10^5 USgpd/ft. for the pumped well (#4), and 3.31×10^5 USgpd/ft. for the observation well (#1). The pumping rate was averaged at 814 USgpm to allow calculation of these values. The coefficient of storage is calculated from the distance-drawdown plot, using a T value of 3.3×10^5 , S is determined as .003. This value is expected in an artesian aquifer and is a reflection of the incomplete adjustment of the aquifer to pumping due possibly to delayed gravity drainage of the aquifer. A similarly low value (.002) was obtained from analysis of the time-drawdown plot of observation well #1.

Well efficiency is determined from the distance-drawdown plot. The theoretical drawdown at the well casing (0.66 feet from the centre of the pumped well) is 5.08 feet, and the observed drawdown is 18.26 feet.

$$\frac{5.08}{18.26} = 27.8\% \text{ efficient}$$

This compares favourably with the approximate well efficiency as determined from the specific capacity and aquifer transmissivity:

$$44.5 \times 1,500 = 66,750 \text{ (approximate T value)}$$

$$\frac{66,750}{3.3 \times 10^5} = 20.2\% \text{ efficient}$$

This low well efficiency limits the available drawdown and, hence, has a controlling influence on well design and potential yield of these production wells. The low efficiency is attributed to the effects of partial aquifer penetration rather than to incomplete well development.

An automatic water level recorder was installed on well #1, 1,200 minutes after the pump was shut off in well #4. The resultant hydrograph (figure 6) shows the continued long-term recovery for a period of some 10 days. The well reached original static (81.60 feet) after 2,220 minutes of recovery, but continued to recover to 81.37 feet after a total recovery time of 15,500 minutes (10.7 days). The length of the recovery period is surprising and perhaps is in part attributable to rising river levels.

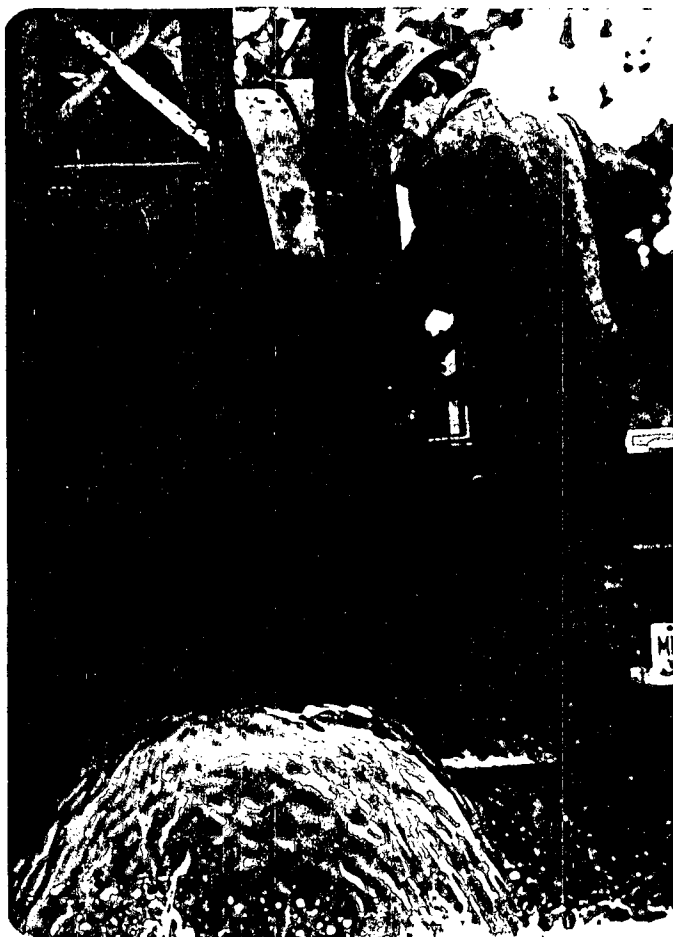


Photo 5. Swabbing a 16-inch test production well, site #1. Note the slightly silty water.



Photo 6. View of the well head during the pumping test on well #4, site #1. Note the flow meter and the discharge line of collapsible 'fireman's hose'.

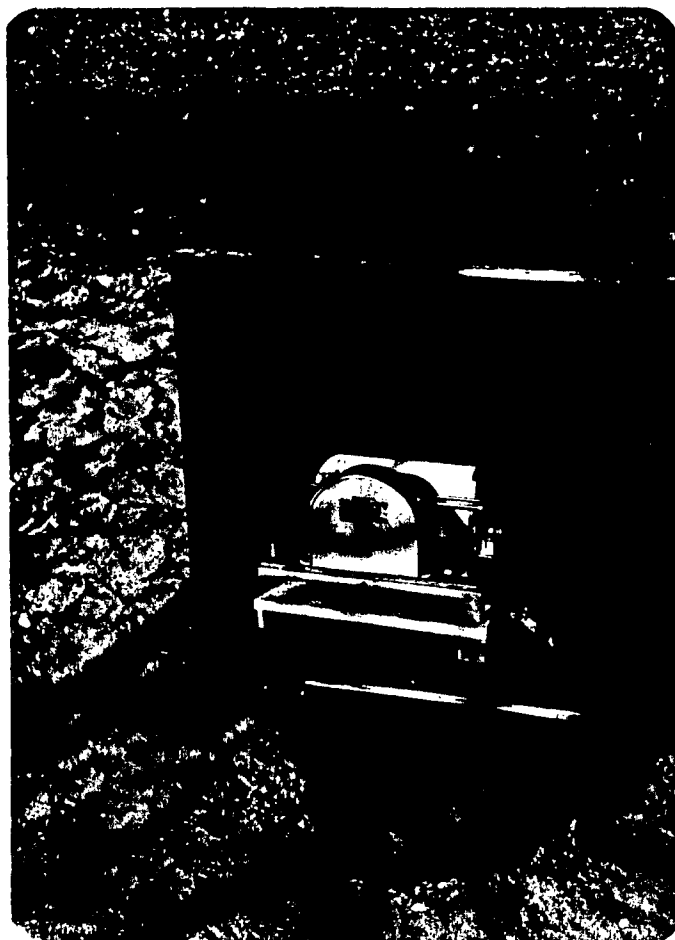


Photo 7. Automatic water-level recorder installed on well #4, site #1 during pumping test #5. Recorder is equipped with gear ratios of 1:1.



Photo 8. Rossum sand tester mounted on well #6, site #1. During this pumping test some 10 ppm of sand were being pumped which soon dropped to less than 1 ppm.



Photo 9. Orifice flow pipe registering 1012 USgpm from well #6, site #1. The pipe is 8 inches in diameter with a 6-inch orifice plate. Note the food colouring added to the glass tube making for easy measurement of the head.

Test hole #5 was tested at 678 USgpm for 155 minutes and at 1,001 USgpm for a total pumping time of 1,440 minutes (Table 2). Automatic water-level recorders were installed on the three observation wells (#1, #4, #6) during the pumping and subsequent recovery period (Photo 7). A velocity recorder was installed below the pump in well #5. It was hoped that this instrument would record the relative velocity of water entering the various sections of screen, but unfortunately, the instrument would not function properly. Concern over sanding problems prompted the use of a Rossum sand tester (Photo 8). Initial sand pumping rates were in the order of 10 ppm. Within an hour this rate had dropped to 5 ppm, and then less than 1 ppm for the remainder of the test.

TABLE 2

PUMPING TEST #5 - WELL PERFORMANCE

Q - 1,001 USgpm				
Total pumping time = 1,440 minutes				
Well #	1	4	5	6
Total drawdown	1.07	1.23	23.90	1.11
Total recovery (after 1,440 minutes)	0.84	0.96	23.60	0.88
Incomplete recovery	0.23	0.27	0.30	0.21
Distance from pumping well	203	157	0	157
Specific capacity			41.9	

The drawdown after 155 minutes of pumping was 16.28 feet for a specific capacity of 41.7 USgpm/ft. The drawdown in well #1 at the same time was 0.41 feet, and in well #4, 0.46 feet, and 0.43 feet in well #6. The drawdown in pumping well #5 after 1,440 minutes was 23.90 feet, for a specific capacity of:

$$\frac{1001}{23.90} = 41.9 \text{ USgpm/ft.}$$

At the same time the drawdown in well #1 was 1.07 feet, in well #4, 1.23 feet, and in well #6, 1.11 feet.

Transmissivities were in the order of 3.3×10^5 USgpd/ft. and storage values 0.12. The transmissivity between well #5 and well #6 was somewhat higher than that between well #5 through well #4 to well #1, being 4.0×10^5 USgpd/ft. Analysis of the distance-drawdown data resulted in similar values for transmissivity and storage. Well efficiency, calculated from the same plot, is 20.8% which agrees favourably with the approximate efficiency determined from the specific capacity and transmissivity:

$$41.1 \times 1,500 = 62,850 \text{ (approximate T)}$$

$$\frac{62850}{3.3 \times 10^5} = 19.0\% \text{ (efficiency)}$$

Test hole #6 was pumped at 945 USgpm for 4.5 minutes and thereafter at 1,012 USgpm. An orifice pipe was used to determine the well yield (Photo 9). The total pumping time was 1,440 minutes (Table 3). This pumping test began after a period of 1,440 minutes had elapsed to allow for recovery following the pumping test on well #5. In each well the recovery to original static was incomplete. Again, a Rossum sand tester was used to record the concentration of sand being pumped. Initially, as much as 10 ppm of sand was being pumped. Within two hours this had dropped to approximately 1 ppm. Automatic water-level recorders were installed on the three observation wells and again, excellent drawdown and recovery data were obtained.

TABLE 3
PUMPING TEST #6 - WELL PERFORMANCE

Q = 1,012 USgpm				
Total pumping time = 1,440 minutes				
Well #	1	4	5	6
Total drawdown	0.49	0.55	1.01	22.19
Total recovery	0.40	0.25	0.93	22.05
		(after 300 min.)		
Incomplete recovery	0.09	0.30	0.08	0.14
Incomplete recovery	0.23	0.27	0.30	0.21
from previous test (#5)				
Distance from pumping well	360	314	157	0
Specific capacity				45.6

After 1,440 minutes, the water level in pumping well #6 had drawn down 22.19 feet.

Specific capacity = $\frac{1,012}{22.19} = 45.6$ USgpm/ft. At the same time, the drawdown in the adjacent wells was 0.49 feet in well #1, 0.55 feet in well #4, and 1.01 feet in well #5.

Calculated transmissivities were in the range of 4.86×10^5 USgpd/ft. Storage coefficients ranged from 0.03 to 0.11. These T values are significantly higher than those obtained from analysis of pumping test #5. It is expected that this can be explained by the incomplete recovery from the previous test (#5) prior to the beginning of pumping test #6.

Aquifer Analysis

Three observation wells were monitored during the pumping of wells #5 and then #6. Automatic water level recorders on each of the observation wells allowed the collection of continuous drawdown and recovery hydrographs (Appendix D). A plot of this data (Appendix C) shows that the transmissivity varied with time, and for the initial 100-150 minutes, T values were in the order of 10^6 USgpd/ft. There is a pronounced change in the rate of drawdown at this time indicating a decrease in transmissivity by a power of ten (i.e., $T = 10^5$). A similar decrease in transmissivity is seen on the recovery plots. This decrease in transmissivity may be explained by the variation in lateral and vertical permeabilities of the aquifer. Initially, the more permeable layers supply much of the pumped water resulting in a long, flat cone of depression, hence, little drawdown in the observation wells. Calculated transmissivity from this initial data is very high and the coefficient of storage is indicative of confined conditions (see Appendix C for log/log plots). The change in rate of drawdown reflects the effects of gravity (vertical) drainage which replenishes the cone of depression and slows its rate of expansion, thus increasing the rate of drawdown. It is felt that well losses, or decreasing permeability at some distance from the well (i.e., a discharge boundary) do not explain the drawdown curve.

An acceptable aquifer transmissivity from pumping test #5 is 3.3×10^5 USgpd/ft. Higher transmissivities were recorded in observation well #6 (3.6×10^5 USgpd) indicating an increase in permeability towards the west (Table 4).

TABLE 4
PUMPING TEST #5 - AQUIFER ANALYSIS

	<u>T Values</u> <u>(USgpd/ft.)</u>	<u>S Values</u>
Well #1		
drawdown	3.3×10^5	0.11
recovery	4.25×10^5	
log/log	3.5×10^5	0.09
Well #4		
drawdown	3.1×10^5	0.14
recovery	2.83×10^5	
log/log	2.9×10^5	0.15
Well #5		
drawdown	2.9×10^5	
recovery	4.25×10^5	
Well #6		
drawdown	3.67×10^5	0.12
recovery	4.18×10^5	
log/log	4.25×10^5	0.09
Distance drawdown using wells #4, #1	3.45×10^5	0.1

(Note that after 1,440 minutes of pumping well #5, the drawdown in well #4, 157 feet to the east, was 1.23 feet, and that the drawdown in well #6, 157 feet to the west, was 1.11 feet (Table 2).

A similar set of results was obtained from pumping test #6 (Table 5 and Appendix C). Again, there was a marked change in transmissivity after 100-150 minutes of pumping. Initial T values are in the order of 10^6 USgpd,

but later T values approximate 5.9×10^5 USgpd/ft. This value is significantly greater than that obtained from analysis of pumping test #5. The storage coefficients range from 0.03 to 0.1, which is slightly lower than those obtained from pumping test #5. This is adequately explained by the incomplete recovery following pumping test #5. Because of the disturbed condition of the water table, drawdown during the subsequent pumping test did not reach equilibrium conditions.

TABLE 5
PUMPING TEST #6 - AQUIFER ANALYSIS

	T Values (USgpd/ft.)	S Values
Well #1		
drawdown	6.85×10^5	0.077
recovery	5.9×10^5	
log/log	7.25×10^5	0.085
Well #4		
drawdown	5.57×10^5	0.1
recovery	6.36×10^5	
log/log	5.27×10^5	0.11
Well #5		
drawdown	5.8×10^5	0.039
recovery	4.86×10^5	
log/log	6.27×10^5	0.03
Well #6		
drawdown	4.86×10^5	
recovery	5.8×10^5	
Distance drawdown using wells #5, #4, #1	3.63×10^5	0.17

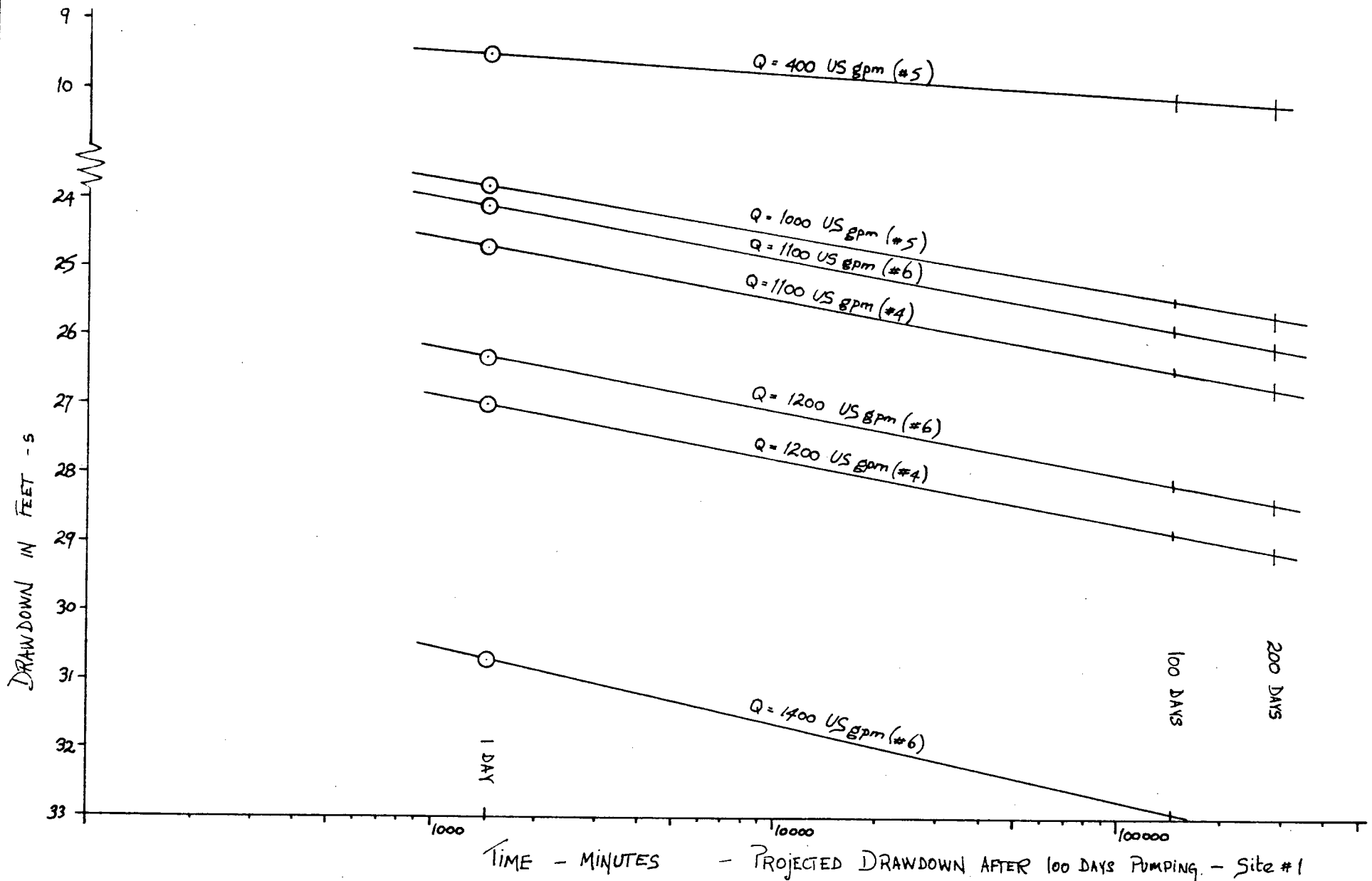
Well Capacities

The capacity of each of the three production wells at this site is limited by the designed screen capacity and to a lesser extent, the available

drawdown and the interference produced by the adjacent wells. Screen capacity is determined from the area of openings in the screen at an assumed entrance velocity of 0.1 ft/sec. The available drawdown is measured from the static water level down to the top of the screen assembly. Interference is calculated from the Theis non-equilibrium formula using a transmissivity of 3.3×10^5 USgpd/ft. and a storage coefficient of 0.1. The transmitting capacity of the well screens should not be exceeded and are thus the maximum capacities of wells #4, #5 and #6.

Well #	Screen Transmitting capacity (USgpm)	Available drawdown (ft)	Specific capacity (USgpm/ft)	60% of maximum theoretical capacity (USgpm) (available drawdown x specific capacity)
1	510	79	6.5	308
4	1195	60	44.5	1602
5	1132	54	42.0	1361
6	1443	56	45.6	1532

The required volume of water to be supplied from this site was in the order of 2500-3000 USgpm (pers comm Mr. Ken Pleasance, Project Engineer). A small portion of this volume was required for domestic supply. Thus it was felt feasible to install a 50 HP pump (presently in service supplying river water to the District) and two higher capacity pumps into the three 16-inch wells. (See memoranda on file 0249723-A vol. 5 and NTS 82E/4 in Groundwater Section files). The 50 HP pump was installed in well #5 and is capable of delivering 400 USgpm for the domestic supply. Pump design requirements determined that wells #4 and #6 be completed with pumps capable of yielding 1100 USgpm each (per comm Mr. Ken Pleasance - project engineer). The projected drawdown after 100 and 200 days pumping is plotted for these pumping rates (figure 10). The following table (Table 6) of well performance is based on the above pumping rates and calculated interference using $T = 3.3 \times 10^5$ USgpd/ft. and $S = 0.1$.



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FILE No. 0249723 - A

DWG. No. Figure 10

DATE

40

ENGINEER

WELL #5

Drawdown at	t=1 day	t=100 days	t=200 days
Yield Q = 400 USgpm	9.52	10.16	10.21
Interference from			
#4 (Q = 1100 USgpm r=157 ft)	1.12	3.2	3.37
#6 (Q = 1100 USgpm r=157 ft)	1.12	3.2	3.37
Total drawdown with all wells pumping (ft)	11.76	16.56	16.95
% of available drawdown (54 ft)	21.8	30.7	31.4

WELL #4

Drawdown at	t=1 day	t=100 days	t=200 days
Yield Q = 1100 USgpm	24.72	26.5	26.75
Interference from			
#5 (Q = 400 USgpm r=157 ft)	0.43	1.16	1.22
#6 (Q = 1100 USgpm r=314 ft)	0.65	2.67	2.83
Total drawdown with all wells pumping (ft)	25.80	30.33	30.80
% of available drawdown (60 ft)	43.0	50.6	51.3

WELL #6

Drawdown at	t=1 day	t=100 days	t=200 days
Yield Q = 1100 USgpm	24.12	25.9	26.18
Interference from			
#4 (Q = 1100 USgpm r=314 ft)	0.65	2.67	2.83
#5 (Q = 400 USgpm r=157 ft)	0.43	1.16	1.22
Total drawdown with all wells pumping (ft)	25.20	29.73	30.23
% of available drawdown (56 ft)	45.0	53.1	54.0

It can be seen that the maximum drawdown is less than 55% of that available. Thus it is concluded that the well field can operate safely at the designed yields. The favourable effects of return flow from irrigation and precipitation are not considered in these calculations.

Monitoring of the performance of the pumping water level will allow a reliable appraisal of the response of this aquifer to the seasonal pumping conditions and also determination of the maximum safe yield from well #5.

SITE #2

Wells #2 and #3 were drilled on site #2 located on the edge of the Cawston Bench at the western boundary of the Fairview Heights Irrigation District (figures 1 and 10). Access to this site is afforded via a right-of-way along the southern boundary of lot 31, Mr. Ramsey MacDonald's property. Site #1 lies approximately $\frac{1}{2}$ mile to the east.

Geology

This site is underlain by medium-to-coarse compact gravels overlying coarse sandy gravels which become more sandy with depth. A general log of this sequence (from test hole #2) is:-

- | | | | |
|-----|---|-----|---|
| 0 | - | 65 | generally coarse compact gravel containing minor amounts of sand and silt |
| 65 | - | 163 | generally coarse sandy gravel with occasional silty sand horizons |
| 163 | - | 201 | medium coarse sand with minor amounts of gravel and fine sand. |

The water table lies some 46 feet below ground at an elevation of 1290.0 feet, which approximates that of the Similkameen River one mile to the west.

Well Design

Test hole #2 is 8 inches in diameter and located towards the south end of site #2 on the edge of Cawston Bench (figure 10). This well was

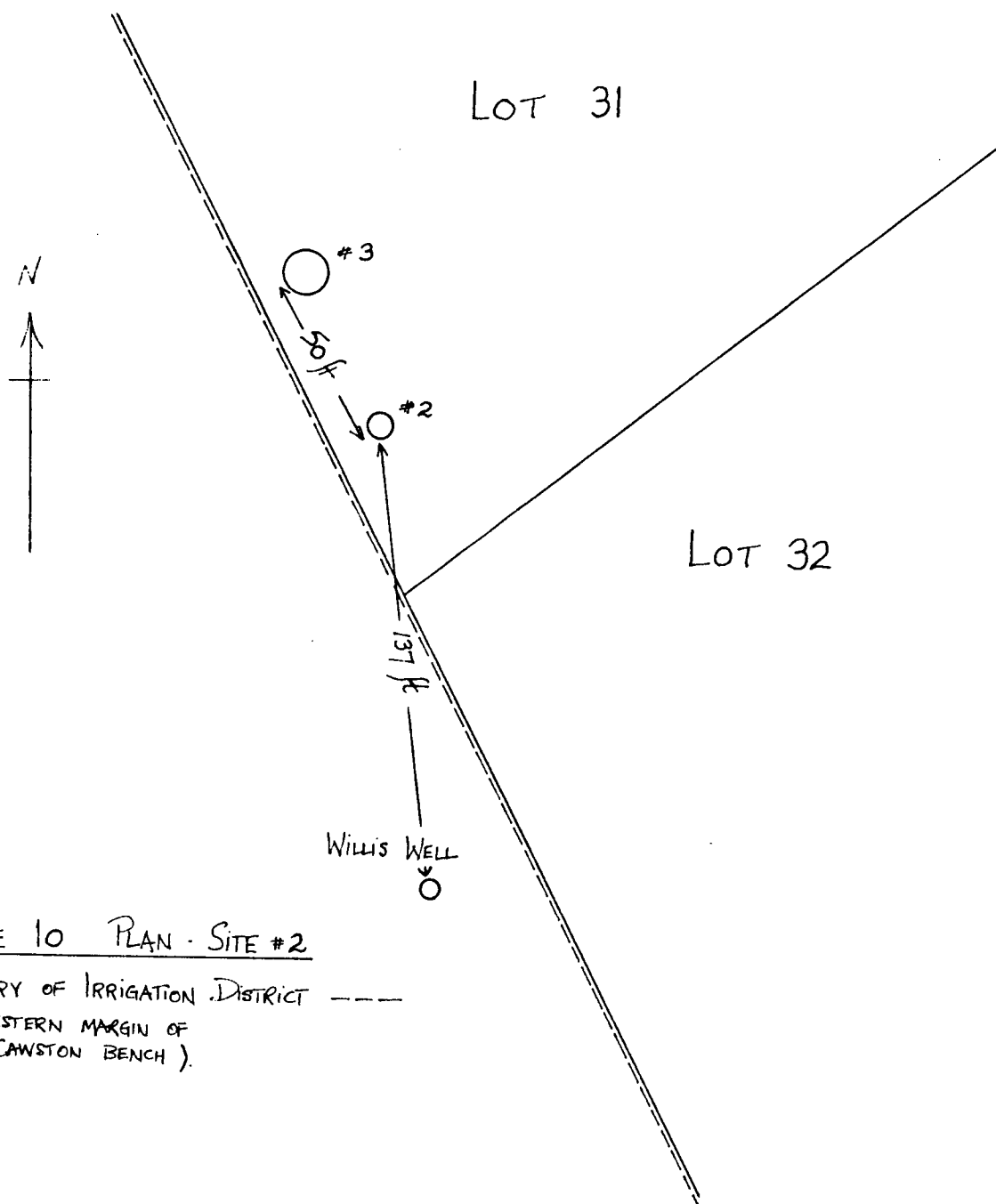


FIGURE 10 PLAN - SITE #2

BOUNDARY OF IRRIGATION DISTRICT ----
(AND WESTERN MARGIN OF
CAWSTON BENCH).

BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.

HOR. 1 cm = 20 feet

DATE

J. M. PETRIE

ENGINEER

FILE No. 0249723-A

DWG. No. FIGURE 11

drilled to a total depth of 201 feet and encountered the materials logged above. (For log and construction details, see appendix E). The sieve analysis of the aquifer materials showed that the more favourable sediments existed above 160 feet, and subsequently this well was completed with a 20-foot length of 150-slot, 8-inch nominal stainless steel water well screen set between 140 and 160 feet. This screen has a designed capacity of 980 USgpm at an entrance velocity of 0.1 ft/sec (appendix E). The well developed easily in $2\frac{1}{2}$ days using bailing, surging and swabbing techniques. The static water level is 46 feet below ground level.

A 24-hour pumping test of this well showed it to have a specific capacity of 137 USgpm/ft and an aquifer transmissivity in the order of 10^6 USgpd/ft.

Test hole #3 is a 16-inch test production well drilled 50 feet to the north of test hole #2. This well was drilled to a total depth of 165 feet and encountered similar materials as those in test hole #2. A general log of this hole is:-

- 0 - 157 medium to coarse pebbly gravel containing
silty sand horizons - sand content increasing
with depth
- 157 - 162 medium coarse sand containing pebbles and silt
- 162 - 165 medium coarse pebbly gravel, which contains
some silt.

(For log and construction details see appendix E).

This section of the aquifer has a greater sand content and the gravel is less coarse than at test hole #2, indicating that conditions for groundwater development may become less favourable to the north.

This well was completed with 30 feet of 180-slot 12-inch nominal stainless steel water well screen set between 127-157 feet below ground. The screen has a designed transmitting capacity of 2,400 USgpm at an entrance velocity of 0.1 ft/sec, (see screen design table, Appendix E). The well was developed in five days by swabbing and then surging above the screen and then finally inside the screen.

The static water level lies some 48 feet below ground level at an elevation of 1290 feet a.s.l.

A pumping test of 950 minutes duration was conducted on this well. The resulting specific capacity was 210 USgpm/ft and the well efficiency was 17.5%. The increased screen length, diameter and slot opening (over #2 well screen) led to an improved specific capacity and well efficiency.

Pumping Tests

Test hole #2 was tested at 503 USgpm for 60 minutes, 781 USgpm for a further 140 minutes and 668 USgpm for a total pumping time of 1440 minutes. The average pumping rate was 672 USgpm. (See Appendices F and G for pumping data and graphical solution of aquifer parameters). The well yield was measured with both a flow meter and an orifice flow pipe (photo 8). As during the pumping test on test hole #1, the flow meter was found to be inaccurate.

After 1440 minutes of pumping, the water level has drawn down 4.89 feet for a specific capacity of 137 USgpm/ft. On pump shutdown, the water level rebounded to above original static, settled out and then slowly recovered.

Aquifer transmissivity as calculated, using the straight line method (see Appendix 9), is 1.04×10^6 USgpd/ft for the drawdown data and 1.77×10^6 USgpd/ft for the recovery data. The approximate well efficiency is:-

$$137 \times 1500 = \frac{205500}{1.77 \times 10^6} = 11.6\%$$

Test hole #3 was pumped for a total time of 1040 minutes (appendix F) but after 46 minutes the pump was shut down for 44 minutes because of mechanical problems. Thus, the first 90 minutes of the pumping test is ignored and the total pumping time is considered as 950 minutes. After pumping for 950 minutes at a rate of 1837 USgpm, the water level had drawn down 8.73 feet for a calculated specific capacity of 210 USgpm/ft (Table 7).

The water level in the observation well 50 feet to the south, (test hole #2) was 1.88 feet below original static level. In the Willis well, a private domestic well 186 feet away, the water level was lowered 1.01 feet. When the pump was shut off, the water level rebounded to above original static level, settled out and then slowly recovered.

TABLE 7
PUMPING TEST #3 - WELL PERFORMANCE

Q = 1837 USgpm

Total pumping time = 950 minutes

Well #	3	2	Willis
Total drawdown	8.73	1.88	1.01
Total Recovery (after 500 min)	8.47	1.85	0.81
Incomplete recovery	0.26	.03	0.20
Distance from pumping well (ft)	0	50	186
Specific capacity	210		

Aquifer Analysis

Analysis of the drawdown and recovery data from both pumping tests show T values ranging from 1.01×10^6 to 2.06×10^6 USgpd/ft (Table 8 and Appendix G). A distance drawdown plot shows a T value of 6.47×10^5 USgpd/ft and a storage coefficient of .177. It is felt that this relatively low transmissivity is a reflection of local horizontal variations in permeability. Such variations are not seen in the erratic drawdown data, but are seen in the recovery plots. The plot of the recovery data from observation well #2 indicates the possible presence of adjacent less permeable materials. The recovery plots from the Willis well and the pumped well (#3) are influenced by the possible presence of materials with a higher permeability. This may explain the increased drawdown in well #2 which, when plotted on a distance-drawdown graph, produces a steeper cone of depression resulting in a lower T value. Similarly, the high coefficient of storage 0.177 may be explained. Analysis of the data from observation

well #2, after 100 minutes of recovery, results in a T value 1.8×10^6 USgpd/ft which is considered to more reliably reflect local aquifer conditions. A storage coefficient of .1 is used for calculations of well interference.

TABLE 8
PUMPING TESTS #2 and #3 - AQUIFER ANALYSIS

	<u>T Values</u> <u>(USgpd/ft)</u>	<u>S Values</u>
Pumping Well #2		
drawdown	1.04×10^6	
recovery	1.77×10^6	
Pumping Well #3		
drawdown	1.43×10^6	
recovery	1.39×10^6	
Observation Well #2		
drawdown	2.06×10^6	
recovery	1.8×10^6	
Willis Well		
recovery	1.01×10^6	
Distance drawdown using wells #2, Willis	6.47×10^5	.177

Well Capacities

Individual well capacity at this site is limited by the size (capacity) of available pumps. Because of favourable hydrogeologic conditions at this site, transmitting capacity of the well screen is not the limiting factor it is at site #1. In fact, the transmitting capacity of the screen would probably safely be exceeded without damaging the well, although higher entrance velocities will tend to increase the rate of encrustation of material onto the water well screen. This, perhaps, could become a significant factor in terms of well maintenance costs.

Well #	Screen Transmitting capacity (USgpm)	Available drawdown (ft)	Specific capacity (USgpm/ft)	60% of maximum theoretical capacity (USgpm) (available drawdown x specific capacity)
2	980	88	137	7234
3	2400	77	210	9702

Designed pump capacities are 700 USgpm in Well #2 and 2400 USgpm in Well #3 (pers comm Mr. Ken Pleasance, Project Engineer). The following table (Table 9) of well performance and interference is based on the Theis non-equilibrium well formula and projected drawdowns using a T value of 1.8×10^6 USgpd/ft and an S value of 0.1. It is readily apparent from this table that the drawdown resulting from long-term pumping (t=200 days), and the interference produced by the adjacent well, is minimal in terms of the available drawdown in each production well. It must be pointed out, however, that the drawdown recorded in well #2 during the pumping test of well #3 (see Table 7) is equal to the calculated drawdown at well #2 after pumping well #3 for 100 days. This may be attributed to delayed gravity drainage of the aquifer over short duration pumping.

TABLE 9
THEORETICAL WELL PERFORMANCE SITE #2

Well #2	t = 1 day	t = 100 days	t = 200 days
Drawdown (Q = 700 USgpm)	5.11	5.32	5.36
Interference from well #3 (Q = 2400, r = 50 ft.)	1.3	1.88	1.97
Total drawdown with both wells pumping		7.20	7.33
Percentage of available drawdown (88 ft.)		8.2	8.3

<u>Well #3</u>	t = 1 day	t = 100 days	t = 200 days
Drawdown (Q = 2400 USgpm)	11.43	12.12	12.22
Interference from well #2 (Q = 700 USgpm, r = 50 ft.)		0.55	0.58
Total drawdown with both wells pumping		12.67	12.80
Percentage of available drawdown (77 ft.)		16.5	16.6

The assumptions on which the Theis non-equilibrium well formula is based are probably not representative of aquifer conditions at this site. Thus, the long-term drawdown at well #2 may exceed the calculated drawdown by as much as 0.5 feet. However, the favourable effects of return irrigation flow and precipitation have not been considered and may marginally offset this possible increased drawdown. The whole argument becomes somewhat academic when viewed in light of the available drawdown in each production well at this site.

5. WELL FIELD MANAGEMENT

Water Level Monitoring

The calculated pumping water levels of the production wells have been tabulated in earlier sections of this report. The daily monitoring of these water levels is necessary to assess the performance of each well. Thus each well must be equipped with a means of measuring the water level that is accurate to at least 0.5 feet and preferably to 0.1 feet. Automated bubbler systems or electric line equipment are the more suitable water-level measuring devices. A decline in the pumping water level in any one well would indicate a reduction in well capacity. Groundwater depletion would be indicated by a lowering of the water level in all wells including the observation well (well #1). Table 10 shows the calculated drawdown at well #1 produced by the pumping of the adjacent wells. Monitoring of the long-term drawdown at this well will allow the Groundwater Section to analyse the response of this aquifer to long-term pumping.

TABLE 10
CALCULATED DRAWDOWN AT
OBSERVATION WELL #1 SITE #1

	t = 100 days	t = 200 days
Drawdown from well #4 (Q=1100 USgpm r=46 ft.)	4.13	4.30
Drawdown from well #5 (Q=400 USgpm r=203 ft.)	1.08	1.15
Drawdown from well #6 (Q=1100 USgpm r=360 ft.)	2.57	2.77
Total drawdown with all wells pumping (ft.)	7.78	8.22

Long term pumping at site #2 will influence the water level in the adjacent domestic well owned by Mr. Willis. Table 11 shows the calculated interference produced by the pumping of wells #2 and #3. Mr. Alex Laing the well driller, who also drilled Mr. Willis's well, advises that interference of less than 5 feet will have no adverse effect on the operation of the Willis well.

TABLE 11
CALCULATED DRAWDOWN AT WILLIS WELL

	t = 100 days	t = 200 days
Interference from well #2 (Q=700 USgpm r=137 ft.)	0.46	0.49
Interference from well #3 (Q=2400 USgpm r=186 ft.)	1.48	1.57
Total drawdown with both wells pumping (ft.)	1.94	2.06

Samples for chemical analysis should be collected once a year by the local Health Branch to test the bacteriological quality of the water.

Pump Operation

The correct operation of the pumps is required to assure the best performance of the wells. The following points should be followed during pump installation and operation:

1. The pump should be mounted on a concrete pad and not supported on the well casing.
2. The pump should be fitted with a foot valve and the well head should be completed with a check valve.
3. Each well must be equipped with provision for measuring the water level and metering the well production.
4. The well should not be flashed on and off, nor should the well be back flushed. Both these situations can disturb the natural pack developed adjacent to the water well screen which may cause the introduction of sand into the well. The ideal situation is long term continuous pumping which tends to improve well performance with time.

Potential Problems

Encrusting or plugging of well screen openings can cause a deterioration of well performance. The increase in velocity and the reduction of the partial pressure (because of the lowered head adjacent to the well) can promote the precipitation onto the well screen of calcium carbonate. The narrow openings in the well screen (at site #1) and the significant concentration of both calcium and carbonate ions in the groundwaters indicate that encrusting of the well screen may perhaps become a problem. The lowering of the water level in any one well (detected by daily monitoring the pumping water level) may indicate that such a problem exists. Treatment may be relatively easily effected without the removal of the pump.

Sand grains can plug the water well screen causing a reduction in well capacity. This is not a common problem but promoted where the screen openings are narrow and the well is being periodically back flushed. Treatment usually requires pulling the pump and redeveloping the well.

System Expansion

The required demand can be met by the new system. Well #5 is not being pumped at its safe maximum which is in the order of 1000 USgpm. Careful monitoring of the performance of all the wells at site #1 will allow an assessment of the safe maximum pumping rate of this well which may add as much as 600 USgpm to the well field capacity. Well #1 is presently not equipped with a pump. It was drilled as a test hole, completed with 30 feet of 30-slot 6-inch nominal water well screen and then gravel packed. This well has a very low capacity and minimal amounts of overpumping and back flushing could seriously disturb the gravel pack allowing the introduction of aquifer material into the well. This well serves more use as an observation well rather than as a production well.

Two other sites can be considered for the construction of a production water well. The District own some land to the north of the present well sites. A well located on this site (the corner of Barcello Road and Coulthard Avenue) would intersect similar materials as those encountered at site #1. The water table would lie some 60-80 feet below ground. These fine sands can yield large volumes of water as demonstrated by wells #4, #5, and #6.

The second site lies on the floodplain adjacent to the edge of Cawston Bench (lot 45 - owned by Mr. T. Mennell) towards the south end of the District. It is expected that this area is underlain by sands and gravels similar to those underlying site #2. The water table here is expected to be 10 feet below the ground. The shallow water table and the more favourable materials allow for cheaper well construction at this site.

6. CONCLUSIONS

A program of well drilling and testing demonstrated the existence of a highly permeable water-table aquifer underlying the Cawston Bench. The water table, which lies 80 feet below ground at site #1 and 46 feet below ground at site #2, approximates the elevation of the Similkameen River. The seasonal water-table fluctuation is in the order of 2-3 feet. The groundwater is of the calcium-bicarbonate-sulphate type. Water quality is not expected to vary through the pumping season, or over a long term period of production.

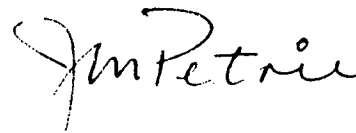
At site #1, the aquifer sands have a transmissivity of 3.3×10^5 USgpd/ft and the more coarse sands and gravels at site #2 have a transmissivity of 1.8×10^6 USgpd/ft. Storage values are in the order of 0.1. The five completed production wells are capable of supplying in excess of 5,500 USgpm. Well yields are limited by the screen capacity and available drawdown at site #1 and by the pump size at site #2. Calcium carbonate encrusting of the well screens may, in the long run, reduce the well capacity. Thus it is strongly recommended that the pumping water level and production data be regularly and accurately recorded.

Well #5 will not be pumped at capacity. Analysis of the water level data will allow an accurate assessment of the aquifer to be undertaken, and the safe maximum pumping rate of this well to be calculated. It is advised that any new wells be constructed at some distance from site #1, preferably at a third well site, located towards the north or the south of the distribution system.

7. RECOMMENDATIONS

- 1) Each well be equipped with a means of accurately measuring the static and pumping water levels.
- 2) Each well be equipped with a flow meter capable of reading the instantaneous flow and total gallons pumped.
- 3) Daily readings of water levels and flows be taken and recorded.
- 4) The wells must not be overpumped.

- 5) These records be assessed by the Groundwater Section at the end of the first year of operation to determine the adequacy of well performance.
- 6) Ideally the pump should have a long pumping cycle and on shut down must not back flush the well.
- 7) Pump houses should be designed with a removable roof and sidewall to allow well maintenance, removal of the pump and redevelopment of the well, if and when this is necessary.



J. M. Petrie
Geologist
Groundwater Section
Hydrology Division
Water Investigations Branch

8. REFERENCES

- 1) British Columbia Water Resources Service (1967): Keremeos Irrigation District - unpublished notes on test drilling results - by J. Parry, Groundwater Section, Water Investigations Branch.
- 2) Johnson (1975) Groundwater and Wells - Edward E. Johnson Inc. Editor - Johnson Division UOP Inc. - Saint Paul, Minnesota.
- 3) Pleasance K.N. (1976) Report on Fairview Heights Irrigation District Proposed system Rehabilitation. Report No. 2274 Water Investigations Branch, British Columbia Department of Lands Forests and Water Resources.
- 4) Ryder J.M. (1970) Alluvial fans of post-glacial environments within British Columbia. Unpubl. Ph.D. thesis, Univ. of British Columbia. Vancouver, British Columbia. 416 pp.
- 5) Ryder J.M. (1971) The Stratigraphy and Morphology of Para-glacial Alluvial Fans in South-central British Columbia. Can. Jour. Earth Sci, Vol. 8, p. 279.

ADDENDUM
AQUIFER TESTING AND
WATERWELL CONSTRUCTION PROJECT
FAIRVIEW HEIGHTS IRRIGATION DISTRICT

ADDENDUM

Pumps were installed in the production wells and began pumping in early 1977. Quantities of sand were found in the system when they first came on line. It was subsequently determined that the sand was introduced from the sump during the shut-down cycle. Consequently the sump was modified and check valves and vacuum breakers installed in the discharge to waste line.

Further testing (Table 1) showed that a quantity of sand was introduced into the wells on start up, but within 20 minutes the rate had dropped to less than 0.5 ppm. Sand measurements varied from well to well and from start up to start up. It is considered most likely that this sand enters the well through the screen and it caused by the backflushing of the well on shut down. The wells do not appear to be pumping sand on a continuous basis and it is expected that more metering of the sand volumes will support this conclusion.

Concern has been expressed over the decreasing performance of well G2. A pumping water level of 93.9 feet was recorded on May 20. Subsequent readings show a higher pumping water level which suggest the May 20 reading was in error. The observer at that time reported he was having trouble with his M-scope.

It can be seen from Table 2 that a specific capacity of 33 USgpm/ft is a good approximation of well performance which is a significant decrease from the 41.9 USgpm/ft obtained from the original pumping test (Table 2, p. 34 - 'Aquifer Testing and Waterwell Construction Project, Fairview Heights Irrigation District'). I suspect that this decrease in well performance can be attributed to the rawhiding and sanding of the well that occurred during the initial start ups. The data available indicate that the well performance is not continually decreasing but this requires verification with the collection of more data.

An indepth analysis of this well is required before considering the replacement of the present 50 hp pump with one of a larger capacity. Such

TABLE 1. VOLUME OF SAND PRODUCED (in parts per million)

Well G1

0-1 minute	15 ppm	0-3 minutes	3 ppm
15-20 minutes	0 ppm	15-120 minutes	0 ppm

Well G2

0-5 minutes	3 ppm
5-20 minutes	0.3 ppm

Well G3

0-1 minute	10 ppm	0-1 minute	15 ppm
1-5 minutes	1.3 ppm	1-5 minutes	0 ppm
5-20 minutes	0 ppm	10-20 minutes	0.5 ppm
		20-100 minutes	0 ppm

Well M1

0-1 minute	40 ppm	0-1 minute	40 ppm
1-2 minutes	10 ppm	1-3 minutes	10 ppm
2-8 minutes	0.5 ppm	3-4 minutes	5 ppm
		5-22 minutes	1 ppm
0-5 minutes	8 ppm	52-72 minutes	0 ppm
5-15 minutes	2.5 ppm	72-187 minutes	<0.5 ppm
15-20 minutes	1 ppm		
20-155 minutes	<0.5 ppm		

Well M2

0-1 minute	40 ppm	0-2 minutes	25 ppm
1-230 minutes	0 ppm	2-5 minutes	0 ppm
		5-960 minutes	<0.5 ppm

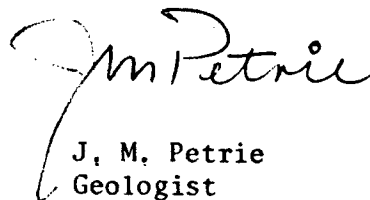
TABLE 2. WATER LEVEL AND
CALCULATED WELL PERFORMANCE - WELL G2 (Well #5, Site #1)

<u>Date</u>	<u>Static Water Level</u>	<u>Pumping Water Level</u>
March 7	67.56 feet (G1, G3 off)	79.45 feet (G1, G3 off)
May 20		93.9 feet? (G1, G3 on)
June 4		88.45 feet (G1, G3 on)
June 21	73.71 feet (G3 on)	84.85 feet (G3 on)

<u>Date</u>	<u>Drawdown</u>	<u>Specific Capacity</u>
March 7	11.89 feet ¹	33.6 USgpm/ft
May 20	24.1 feet ²	18.7 USgpm/ft ?
June 4	13.62 feet ³	33.0 USgpm/ft
June 21	11.14 feet ⁴	40.4 USgpm/ft

1. Pumping rate was 400 USgpm.
2. Static water level was taken from May 20 measurement. Interference from G1 and G3 taken from Table 6, p. 41 in report. Pumping rate was 450 USgpm. This reading is not considered valid.
3. Static water level taken from June 21 measurement. Interference from G1 and G3 taken from report. Pumping rate was 450 USgpm.
4. Pumping rate level taken after only 5 minutes pumping, so comparison of specific capacities not valid. Pumping rate was 450 USgpm.

an analysis can not be completed until the performance of this well is regularly monitored,



J. M. Petrie
Geologist
Groundwater Section
Hydrology Division
Water Investigations Branch

FOOTNOTE:

The production wells on Site #1, the Gardner Site are now numbered G1 to G3.

G1 is Well #4
G2 is Well #5
G3 is Well #5

The production wells on the MacDonald Site (Site #2) are numbered thus:

M1 is Well #3
M2 is Well #2

APPENDIX A

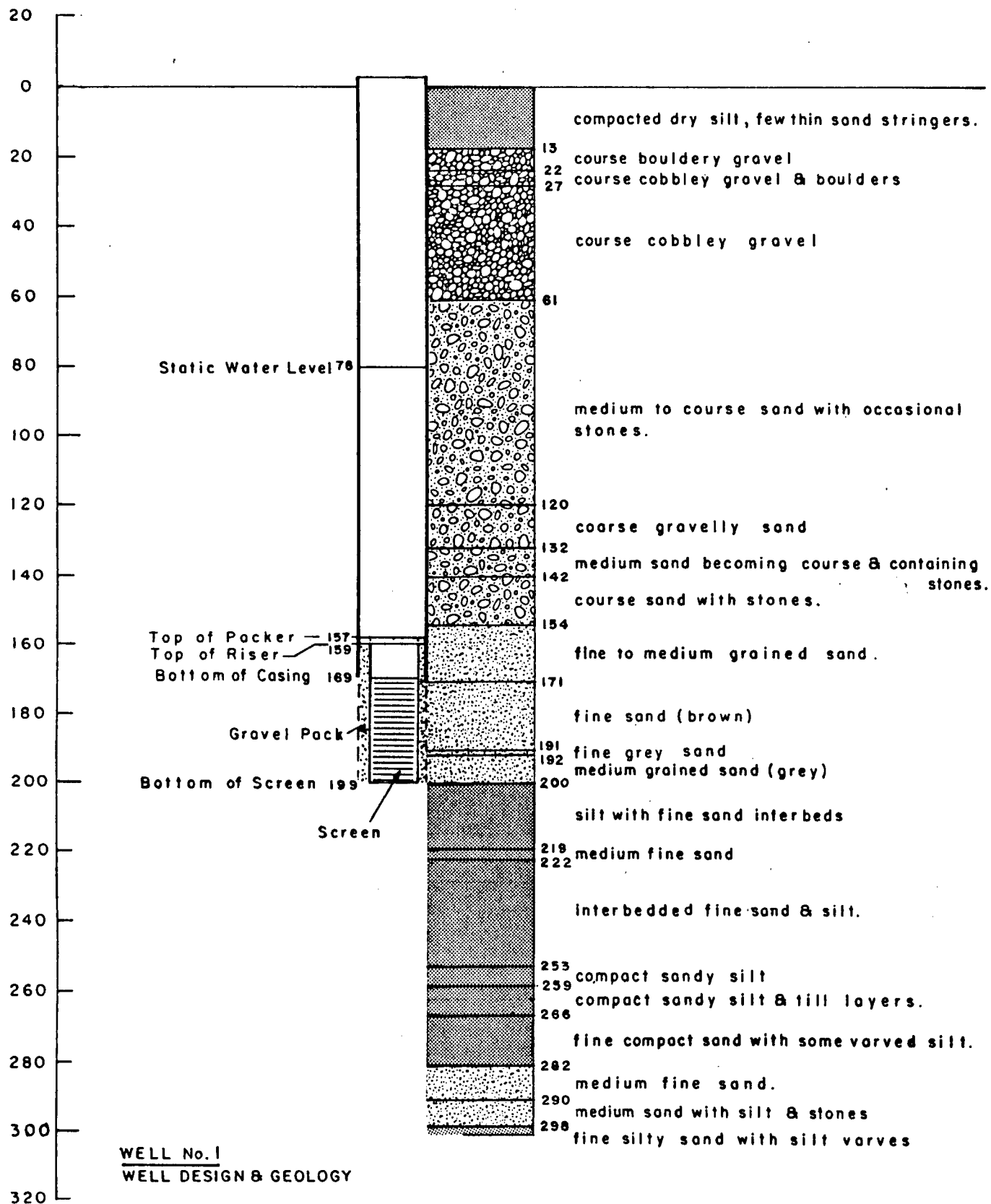
WELL AND SCREEN DATA

SITE #1

APPENDIX A

WELL #1	Well design and geology Representative sieve analysis Screen design table
WELL #4	Well design and geology Screen design table
WELL #5	Well design and geology Screen design table
WELL #6	Well design and geology Screen design table

Complete sieve analysis of all samples are located on the NTS files (82E/4) of the Groundwater Section.



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TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

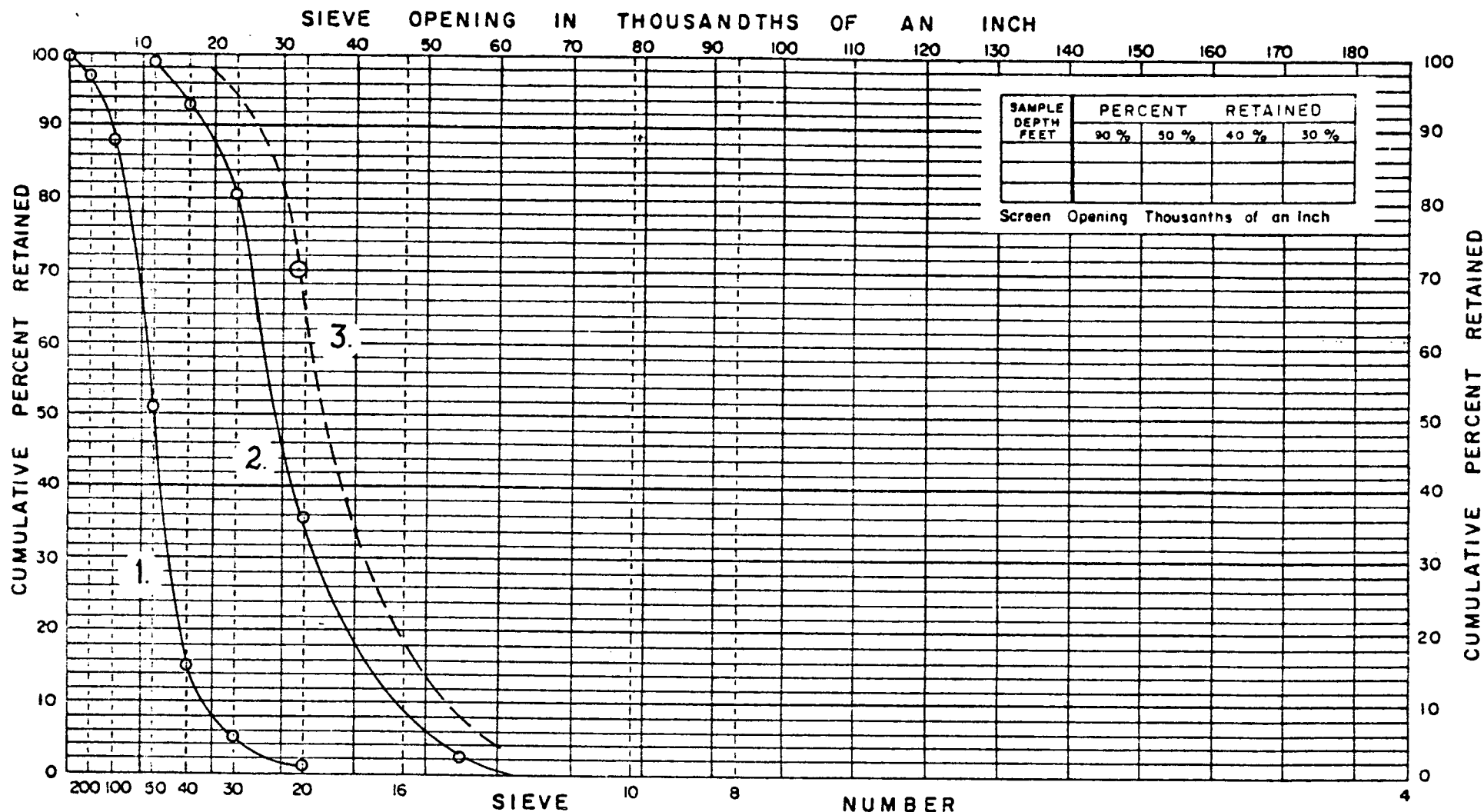
SCALE: VERT. 1" = 40'
HOR. 1" = 16'

DATE

J. M. PETRIE

ENGINEER

FILE No. 0249723 - A DWG. No.



1. Representative sieve analysis curve for screened section (169-199) of test hole #1.
2. Sieve analysis curve of f-16 Monterey filter sand pack.
3. Curve for required sand pack - 70% retained by 32-slot screen.

Well completed with 30-slot screen.
Complete sieve analysis on file in Groundwater Office.

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH GROUNDWATER DIVISION	
SIEVE ANALYSIS	
PROJECT:	Fairview Heights
LOCATION:	Cawston, B.C.
WELL No.	Test Hole #1
SAMPLED BY:	Monkman
SIEVE ANALYSIS BY:	Harris
DATE:	

DESIGN TABLE FOR SCREEN SLOT SIZE AND LENGTH TEST WELL #1

[illegible]

TEST WELL #1

[illegible]

DESIGN TABLE FOR SCREEN SLOT SIZE AND LENGTH TEST WELL #1

[illegible]

20
0
20
40
60
80
100
120
140
160
180
200
220

Static Water Level 76

Top of Packer 136 -
Bottom of Casing 139 -

Screen

189

WELL No. 4
WELL DESIGN & GEOLOGY

light tan silt.

11 compact silty gravel
14 slightly compact medium to coarse pebbly
22 gravel with tan silt.

medium to coarse pebbly gravel with tan
silt, & an increasing content of medium
to coarse sand.

62

medium to fine brown silty sand with
some pebbly gravel, sand becoming
course.

95

medium to coarse sand with some pebbly
gravel.

118

course sand and some pebbly gravel.

132

medium to coarse silty brown sand with
some fine

182

medium to fine brown silty sand with
with thin silt lens at 189.

185 medium to fine silty sand with some coarse
189 sand and fine gravel.
fine silty grey sand.

196 silt interbed.
198 fine silty grey sand.
202 silt interbed
204

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TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT. 1" = 30"
HOR. 1" = 16"

DATE

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ENGINEER

FILE No. 0249723-A

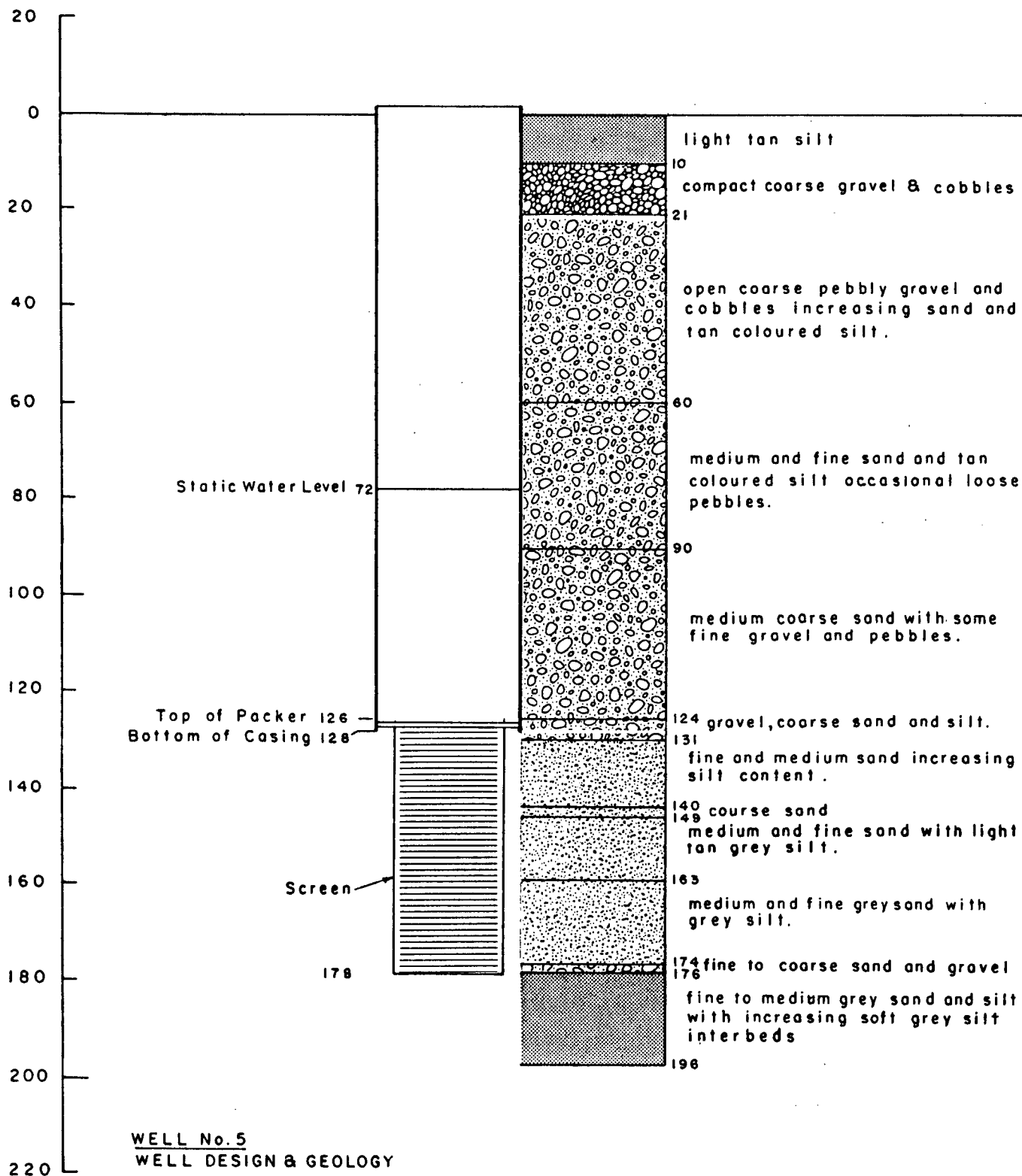
DWG. No.

TEST HOLE #4

[illegible]

TEST HOLE #4

[illegible]



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FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT. 1" = 30'
HOR. 1" = 16'

DATE

J. M. PETRIE

ENGINEER

FILE No. 0249723-A DWG. No.

TEST HOLE #5

[illegible]

20
0
20
4
60
80
100
120
140
160
180
200
220

Static Water Level - 68

Top of Packer - 124
Bottom of Casing - 127

Screen

177

light tan silt.
7 course pebbly gravel.
10
course compact cobbly gravel.
30
medium course pebbly gravel with tan silt.
72 fine gravel and course sand.
76 medium to course sand with fine gravel and occasional pebbles.
108
2" thick silt lens. medium sand with tan silt occasional pebbles below 117.
126 course sand and fine gravel with tan silt.
136 medium to course sand and tan silt.
146 tan silt interbeds.
181 medium to course sand and tan silt.
172
204 medium to fine grey silty sand with occasional thin grey silt interbeds.

WELL No. 6
WELL DESIGN & GEOLOGY

BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT. 1" = 30'
HOR. 1" = 16'

DATE

J. M. PETRIE

ENGINEER

FILE No. 0249723-A DWG. No.

DESIGN TABLE FOR SCREEN SLOT SIZE AND LENGTH TEST HOLE #6

[illegible]

APPENDIX B

PUMPING TEST DATA

SITE #1

APPENDIX B

WELL #1	Drawdown data Recovery data Re-test data
WELL #4	Drawdown data Recovery data Drawdown data - observation well #1 Recovery data - observation well #1
WELL #5	Drawdown data Recovery data Drawdown data - observation well #1 Recovery data - observation well #1 Drawdown data - observation well #4 Recovery data - observation well #4 Drawdown data - observation well #6 Recovery data - observation well #6
WELL #6	Drawdown data Recovery data Drawdown data - observation well #1 Recovery data - observation well #1 Drawdown data - observation well #4 Recovery data - observation well #4 Drawdown data - observation well #5 Recovery data - observation well #5

APPENDIX

"CONSTANT RATE" PUMPING TEST DATA FROM WELL NO. 1

Date 1 October 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	Stick up 1.95' Static 77.27' below ground
3:30 p.m.	0.0	79.22				
	0.5					
	1.0					
	1.5					
	2.0					
	2.5					
	3.0					
	3.5	88.60	9.38		165	calculated from corrected flow meter test
	4.0	100.22	21.00			
	4.5	101.08	21.86			
	5.0	101.24	22.02			
	6	101.41	22.19			
	7	101.49	22.27			
	8	101.56	22.34			
	9	101.49	22.27			
3:40 p.m.	10	101.59	22.37			
	12	101.66	22.44			
	14	101.83	22.61			
	16	101.91	22.69			
	18	101.93	22.71			
	20	101.83	22.61			specific capacity
	25	101.92	22.70			$165/22.86 = 7.22$ USgpm/gt.
	30	102.08	22.86			
	35	101.89	22.67		216	calculated from corrected flow meter test
	36	118.09	38.87			
	37	119.16	39.94			
	38	119.26	40.04			
	39	119.30	40.08			
	40	119.34	40.12			
	42	119.51	40.29			
	44	119.57	40.35			
	46	119.61	40.39			
	48	119.60	40.38			
	50	119.70	40.48			
	55	119.77	40.55			specific capacity
4:40 p.m.	60	119.73	40.51			$216/40.45 = 5.34$ USgpm/ft.
	65	119.67	40.45			

APPENDIX

"CONSTANT RATE" PUMPING TEST DATA FROM WELL NO. 1

Date 1 October 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	
4:40 p.m.	70	119.85	40.63		305	calculated from corrected flow meter test
	71	130.67	51.45			
	72	124.19	44.97			
	73	122.74	43.52			
	74	122.61	43.39			
	75	122.63	43.41			
	76	122.69	43.47			
	77	122.69	43.47			
	78					
	79	122.69	43.47			
	80	122.74	43.52			
	82	122.79	43.57			
	84	122.70	43.48			
	86	122.84	43.62			
	88	122.79	43.57			
5:00 p.m.	90	122.87	43.65			
	95	122.87	43.65			
	100	122.90	43.68			
	105	122.85	43.63			
	110	122.91	43.69			
	115	123.05	43.83			
	120	123.02	43.80			
	125	123.04	43.82			
	150	123.09	43.89		305	
	175	123.19	43.97			
6:50 p.m.	200	123.31	44.09			
	250	123.48	44.26			
	300	123.67	44.45			
	350	123.82	44.60			
10:10 p.m.	400	124.03	44.81			
	450	124.05	44.83			
	500	124.02	44.80			

APPENDIX

"CONSTANT RATE" PUMPING TEST DATA FROM WELL NO. 1

Date 2 October 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	
12:40 a.m.	550	124.06	44.84		305	2 October
	600	124.26	45.04			
	650	124.46	45.24			
	700	124.62	45.40			
	750	124.26	45.04			
	800	124.36	45.14			
	850	124.23	45.01			
	900	124.36	45.14			
	950	124.56	45.34			
8:10 a.m.	1000	124.51	45.29			
	1050	124.40	45.18			
	1100	124.39	45.17			
	1150	124.28	45.06			
11:30 a.m.	1200	124.15	44.93			
	1250	124.22	45.00			
	1300	124.05	44.83			specific capacity
	1350	123.88	44.66			$305/44.89 = 6.79$ USgpm/ft.
	1400	123.93	44.76			pump shut off
3:30 p.m.	1440	124.11	44.89			average Q = 300 USgpm

• APPENDIX

RECOVERY READINGS IN WELL NO. 1 AFTER "CONSTANT RATE" PUMPING TEST

Date 2 October 1975

Time	Time (t) since start of pumping in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet	Residual drawdown in well in feet (static =)	Original water level 79.22'
4:30 p.m.	1440.5 1441	0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 6 7 8 9	2881 1441 961 721 577 481 4124 361 321 289 241 207 181 161	83.41 77.67 77.33 77.42 77.59 77.74 77.91 78.09 78.31 78.47 78.85 79.21 79.47 79.53	-1.55 -1.89 -1.70 -1.63 -1.48 -1.31 -1.13 -0.91 -0.75 -0.37 -0.01 0.25 0.31	
	1450	10 12 14 16 18	145 121 104 91 81	79.52 79.50 79.50 79.50 79.50	0.30 0.28 0.28 0.28 0.28	
	1460	20 25	73 59	79.49 79.49	0.27 0.27	
	1470	30 35	49 42	79.49 79.48	0.27 0.26	
	1480	40 45	37 33	79.48 79.48	0.26 0.26	
	1490	50 55	30 27	79.47 79.42	0.25 0.20	
5:30 p.m.	1500 1510 1520 1530	60 70 80 90	25 21 19 17	79.46 79.45 79.45 79.44	0.24 0.23 0.23 0.22	
5:10 p.m.	1540	100 125	15 12.5	79.42 79.42	0.20 0.20	
5:50 p.m.	1590 1640	150 200	10 8.2	79.40 79.40	0.18 0.18	

* APPENDIX

RECOVERY READINGS IN WELL NO. 1 AFTER "CONSTANT RATE" PUMPING TEST

Date 2 October 1975

Time	Time (t) since start of pumping in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet	Residual drawdown in well in feet (static =)	
	1690	250	6.7	79.38	0.16	3rd October
	1740	300	5.8	79.375	0.155	
9:20 p.m.	1790	350	5.1	79.37	0.15	
	1840	400	4.6	79.39	0.17	
	1890	450	4.2	79.44	0.20	
	1940	500	3.9	79.40	0.18	
12:40 a.m.	1990	550	3.6	79.38	0.16	
1:30	2040	600	3.4	79.34	0.12	
2:20	2090	650	3.2	79.30	0.08	
3:10	2140	700	3.0	79.31	0.09	
4:00	2190	750	2.9	79.31	0.09	
4:50	2240	800	2.8	79.32	0.10	
5:40	2290	850	2.7	79.30	0.08	
6:30	2340	900	2.6	79.30	0.08	
7:20	2390	950	2.5	79.30	0.08	
8:10 a.m.	2440	1000	2.4	79.30	0.08	recovery terminated

APPENDIX

"CONSTANT RATE" PUMPING TEST DATA FROM WELL NO. 1

(RE TEST)

Date 6 October 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	Retest to check flow meter against orifice pipe. Flow meter read too high by a factor of 1.66
11:50 p.m.	0.0	137.90	58.68	46	429	4-inch orifice on 6-inch
	1.0	144.45	65.23			
	2.0	144.96	65.74			
	3.0	144.98	65.76			
	4.0	145.00	65.78			
	5.0	145.03	65.81			
	6.0	145.10	65.88			
	7.0	145.12	65.90			
	8.0	145.17	65.95			
	9.0	145.13	65.91			
	10.0	145.17	65.95			
	11	145.17	65.95			
	12	145.14	65.92			
	14	145.17	65.95			
	16	145.26	66.04			
	18	145.27	66.05			
12:10 a.m.	20	145.32	66.10			7 October
	30	145.14	65.92			
	40	145.43	66.21			
	50	145.41	66.19			
	70	145.59	66.37			
	90	145.65	66.43			
2:10 a.m.	140	145.80	66.58	46	429	specific capacity 429/66.58 = 6.44 USgpm/ft. pumping stopped

PUMPING TEST DATA FROM WELL NO. 4

Date November 27, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 77.87)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	
						Stick up 1.61'
4:50 P.M.	0.0	77.87	0.0			Static 76.26' below ground
	0.5	94.90	17.03	12	728	7-inch orifice on a 10-inch pipe
	1.0	94.37	16.50			
	1.5	93.60	15.73			
	2.0	93.00	15.13			
	2.5	93.18	15.31			
	3.0	92.79	14.92			
	3.5	92.78	14.91			
	4.0	92.87	15.00			
	4.5	92.93	15.06			
	5.0	93.10	15.23			
	6.0	93.26	15.39			
	7.0	93.03	15.16			
	8.0	92.79	14.92			
	9.0	92.74	14.87			Measurements taken with M-scope
5:00 P.M.	10.0	92.69	14.82			
	12.0	92.80	14.93			
	14.0	92.78	14.91			
	16.0	92.81	14.94			
	18.0	92.81	14.94			
	20.0	92.83	14.96			
	25.0	92.98	15.11			
	30.0	93.02	15.15			
	35.0	93.28	15.41			
	40.0	94.93	17.06	15	812	
	45.0	95.09	17.22			
	50.0	95.22	17.35			
	75.0	95.35	17.48			
6:30 P.M.	100.0	95.65	17.78			
	150.0	95.63	17.76			
	200.0	95.63	17.76			
9:00 P.M.	250.0	95.76	17.89			

PUMPING TEST DATA FROM WELL NO. 4

Date November 27, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 77.87)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	
9:50 P.M.	300.0	95.98	18.11	15	812	
	350.0	95.57	17.70			
	400.0	96.21	18.34			
12:20 A.M.	450.0	96.06	18.19			November 28, 1975
	500.0	96.09	18.22			
	550.0	96.14	18.27			
	600.0					
	650.0	96.15	18.28			
	700.0	96.23	18.36			
	750.0	96.21	18.34			
	800.0	96.18	18.31			
	850.0	96.22	18.35			
7:50 A.M.	900.0	96.28	18.41			
	1000.0	96.18	18.31			
	1050.0	96.02	18.15			
	1100.0	96.11	18.24			
12:00 Noon	1150.0	96.26	18.39			
	1200.0	96.28	18.41			
1:15 P.M.	1225.0	96.13	18.26			
	1225.5	100.96	23.09	26	1064	Opened valve 1 turn
	1226.0	101.10	23.23			
	1226.5	101.25	23.38			
	1227.0	101.26	23.39			
	1227.5					
	1228.0	102.31	24.44	29	1124	Opened valve 1 turn
	1228.5	102.72	24.85			
	1229.0	102.65	24.78			
1:20 P.M.	1230.0	102.67	24.80			
	1231.0	102.71	24.84			
	1232.0	102.74	24.87			
	1233.0	105.52	27.65	35	1235	Increased engine speed
	1234.0	105.41	27.54			
	1235.0	105.53	27.66			
	1236.0	105.53	27.66			
	1237.0	105.46	27.59			
	1238.0	105.51	27.64			
	1239.0	105.46	27.59			
	1240.0	105.50	27.63			
1:31 P.M.	1241.0	105.56	27.69			Increased engine speed - but discharge line parted, so pump shut off

RECOVERY READINGS IN WELL NO. 4 AFTER PUMPING TEST

Date November 28, 1975

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well in feet (static = 77.87)	Stick up 1.61'
1:31 P.M.	1241.0	0.0		105.56	27.69	Measurements taken with M-scope
	1241.5	0.5	2483.0	77.51	-0.36	
	1242.0	1.0	1242.0	78.05	0.18	
	1242.5	1.5	828.0	78.05	0.18	
	1243.0	2.0	621.0	78.17	0.30	
	1243.5	2.5	497.0	78.41	0.54	
	1244.0	3.0	414.0	78.57	0.70	
	1244.5	3.5	355.0	78.64	0.77	
	1245.0	4.0	311.0	78.67	0.80	
	1245.5	4.5	276.0	78.67	0.80	
1:36 P.M.	1246.0	5.0	249.0	78.71	0.84	
	1247.0	6.0	208.0	78.19	0.32	
	1248.0	7.0	178.0	78.61	0.74	
	1249.0	8.0	156.0	78.67	0.80	
	1250.0	9.0	139.0	78.65	0.78	
1:41 P.M.	1251.0	10.0	125.0	78.67	0.80	
	1253.0	12.0	104.0	78.64	0.77	
	1255.0	14.0	90.0	78.65	0.78	
	1257.0	16.0	79.0	78.62	0.75	
	1259.0	18.0	70.0	78.68	0.81	
1:51 P.M.	1261.0	20.0	63.0	78.60	0.73	
	1266.0	25.0	50.0	78.64	0.77	
	1271.0	30.0	42.0	78.58	0.71	
	1276.0	35.0	36.0	78.56	0.69	
	1281.0	40.0	32.0	78.65	0.78	
	1286.0	45.0	28.6	78.65	0.78	
2:21 P.M.	1291.0	50.0	25.8	78.58	0.71	
	1301.0	60.0	21.7	78.50	0.63	
	1311.0	70.0	18.7	78.48	0.61	
	1321.0	80.0	16.5	78.48	0.61	
	1331.0	90.0	14.8	78.46	0.59	
	1341.0	100.0	13.4	78.44	0.57	
	1366.0	125.0	10.9	78.44	0.57	
	1391.0	150.0	9.3	78.49	0.62	
	1441.0	200.0	7.2	78.43	0.56	
	1491.0	250.0	5.9	78.45	0.58	

RECOVERY READINGS IN WELL NO. 4 AFTER PUMPING TEST

Date November 28, 1975

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well in feet (static = 77.87)	
7:21 P.M.	1591.0	350.0	4.5	78.26	.39	November 29, 1975 Incomplete recovery
8:11 P.M.	1641.0	400.0	4.10	78.21	.34	
9:01 P.M.	1691.0	450.0	3.8	78.18	.31	
11:31 P.M.	1841.0	600.0	3.1	78.09	.22	
9:31 A.M.	2441.0	1200.0	2.0	77.97	.10	

READINGS TAKEN ON OBSERVATION WELL NO. 1 DURING
PUMPING TEST ON WELL NO. 4

Date November 27, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 81.60)	
4:50 P.M.	0.0	81.60	0.0	Pumping rate 728 U.S. gpm
	0.5	81.68	0.08	
	1.0	83.37	1.77	
	1.5	83.32	1.72	
	2.0	83.35	1.75	
	2.5	83.48	1.88	
	3.0	83.33	1.73	
	3.5	83.23	1.63	
	4.0	83.23	1.63	
	4.5	83.25	1.65	
	5.0	83.30	1.70	
	6.0	83.25	1.65	
	7.0	83.30	1.70	
	8.0	83.27	1.67	
	9.0	83.23	1.63	
	10.0	83.24	1.64	
	12.0	83.23	1.63	
	14.0	83.25	1.65	Pumping rate 812 U.S. gpm
	16.0	83.26	1.66	
5:10 P.M.	18.0	83.24	1.64	
	20.0	83.24	1.64	
	25.0	83.27	1.67	
	30.0	83.28	1.68	
	35.0	83.33	1.73	
	40.0	83.47	1.87	
	45.0	83.52	1.92	
	50.0	83.53	1.93	
	75.0	83.54	1.94	
6:30 P.M.	100.0	83.56	1.96	
	150.0	83.64	2.04	
	200.0	83.76	2.16	
	250.0	83.76	2.16	
	300.0	83.77	2.17	

READINGS TAKEN ON OBSERVATION WELL NO. 1 DURING
PUMPING TEST ON WELL NO. 4

Date November 27, 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 81.60)	
	350.0	83.82	2.22	
	400.0	84.41	2.81	
2:20 A.M.	450.0	83.96	2.36	November 28, 1975
	500.0	83.97	2.37	
	550.0	83.99	2.39	
	650.0	84.07	2.47	
	700.0	84.19	2.59	
	750.0	84.19	2.59	
	800.0	84.16	2.56	
	850.0	84.21	2.61	
	900.0	84.15	2.55	
	950.0	84.18	2.58	
9:30 A.M.	1000.0	84.17	2.57	
	1050.0	84.14	2.54	
	1100.0	84.15	2.55	
12:00 Noon	1150.0	84.22	2.62	
	1200.0	84.18	2.58	
1:15 P.M.	1225.0	84.17	2.57	
1:16 P.M.	1226.0	84.58	2.98	Pumping rate 1064 U.S. gpm
	1227.0	84.71	3.11	
	1228.0	84.80	3.20	Pumping rate 1124 U.S. gpm
	1229.0	84.87	3.27	
	1230.0	84.92	3.32	
	1231.0	84.92	3.32	
	1232.0	84.90	3.30	
	1233.0	85.11	3.51	Pumping rate 1235 U.S. gpm
	1234.0	85.17	3.57	
1:25 P.M.	1235.0	85.18	3.58	
	1237.0	85.18	3.58	
	1239.0	85.19	3.59	
	1241.0	85.19	3.59	Discharge line parted, pump shut off

RECOVERY READINGS ON OBSERVATION WELL NO. 1 AFTER
PUMPING TEST ON WELL NO. 4

Date November 28, 1975

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well in feet (static = 81.60)	
1:31 P.M.	1241.0	0.0		85.19	3.59	
	1242.0	1.0	1242.0	82.46	0.86	
	1243.0	2.0	621.0	82.20	0.60	
	1244.0	3.0	414.0	82.30	0.70	
	1245.0	4.0	311.0	82.30	0.70	
	1246.0	5.0	249.0	82.30	0.70	
	1247.0	6.0	208.0	82.26	0.66	
	1248.0	7.0	178.0	82.25	0.65	
	1249.0	8.0	156.0	82.26	0.66	
1:40 P.M.	1250.0	9.0	139.0	82.26	0.66	
	1251.0	10.0	125.0	82.27	0.67	
	1253.0	12.0	104.0	82.26	0.66	
	1255.0	14.0	90.0	82.25	0.65	
	1257.0	16.0	79.0	82.25	0.65	
	1259.0	18.0	70.0	82.24	0.64	
	1261.0	20.0	63.0	82.22	0.62	
	1266.0	25.0	50.0	82.21	0.61	
	1271.0	30.0	42.0	82.19	0.59	
	1277.0	35.0	36.5	82.20	0.60	
	1281.0	40.0	32.0	82.18	0.58	
	1286.0	45.0	28.6	82.17	0.57	
	1291.0	50.0	25.8	82.16	0.56	
	1301.0	60.0	21.7	82.17	0.57	
	1311.0	70.0	18.7	82.12	0.52	
	1321.0	80.0	16.5	82.16	0.56	
	1331.0	90.0	14.8	82.10	0.50	
3:11 P.M.	1341.0	100.0	13.4	82.11	0.51	
	1366.0	125.0	10.9	82.23	0.63	
	1391.0	150.0	9.3	82.14	0.54	
	1441.0	200.0	7.2	82.11	0.51	
5:41 P.M.	1491.0	250.0	5.9	82.09	0.49	

RECOVERY READINGS ON OBSERVATION WELL NO. 1 AFTER
PUMPING TEST ON WELL NO. 4

Date November 28, 1975

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well in feet (static = 81.60)	Remarks
	1591.0	350.0	4.5	81.93	0.33	
	1641.0	400.0	4.1	81.91	0.31	
	1691.0	450.0	3.7	81.90	0.30	
11:31 P.M.	1841.0	600.0	3.1	81.84	0.24	
9:31 A.M.	2441.0	1200.0	2.03	81.71	0.11	
						November 29, 1975 Monthly recorder installed on well. Long term recovery can be seen on December hydrograph, Fig. 6

PUMPING TEST DATA FROM WELL NO. 5

Date February 20, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	Stick up 1.10' Static 71.59' below ground
2:30 P.M.	0.0	72.69	0.0			Readings taken with M-scope
	0.5					
	1.0	100.76	28.07			
	1.5	100.08	27.39			
	2.0	99.26	26.57			
	2.5	90.46	17.77			
	3.0	88.53	15.84			
	3.5	90.68	17.99			
	4.0	90.22	17.53			
	4.5	89.93	17.24			
	5.0	89.09	16.40			
	6.0	88.96	16.27			
	7.0	88.95	16.26	23.0	678.0	6 inch. orifice on 10 inch pipe
	8.0	88.96	16.27			
	9.0	88.96	16.27			
	10.0	88.96	16.27			
	12.0	88.95	16.26			
	14.0	88.96	16.27			
	16.0	88.96	16.27			
	18.0	88.96	16.27			
	20.0	88.96	16.27			
	30.0	88.96	16.27			
	40.0	88.96	16.27			
	50.0	88.98	16.29			
	60.0	88.99	16.30			
	90.0	89.04	16.35			
	140.0	88.97	16.28			
	156.0	95.85	23.16	23.0	1001.0	7 inch. orifice on 10 inch pipe
	157.0	95.88	23.19			
	158.0	95.85	23.16			
	159.0	95.86	23.17			
3:10 P.M.	160.0	95.86	23.17			

PUMPING TEST DATA FROM WELL NO.5

Date February 20, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	
	165.0	95.87	23.18	23.0	1001.0	
	170.0	95.87	23.18			
	175.0	95.87	23.18			
3:50 P.M.	200.0	95.90	23.21			
	250.0	96.00	23.31			
	300.0	96.08	23.39			
	350.0	96.14	23.45			
	460.0	96.20	23.51			
9:50 P.M.	560.0	96.27	23.58			
	660.0	96.33	23.64			
1:10 A.M.	760.0	96.38	23.69			February 21, 1976
7:00 A.M.	1110.0	96.49	23.80			
	1260.0	96.58	23.89			
2:30 P.M.	1440.0	96.59	23.90			Pump shut off

RECOVERY READING IN WELL NO.5 AFTER PUMPING TEST

Date February 21, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well	
2:30 P.M.	1440.0	0.0	--	96.59	23.90	Readings taken with M-scope
	1440.5	0.5	2882.0	72.19	-0.50	
	1441.0	1.0	1441.0	72.65	-0.04	
	1441.5	1.5	961.0	72.78	0.09	
	1442.0	2.0	721.0	72.93	0.24	
	1442.5	2.5	577.0	73.09	0.40	
	1443.0	3.0	481.0	73.28	0.59	
	1443.5	3.5	412.0	73.53	0.84	
	1444.0	4.0	361.0	73.58	0.89	
	1444.5	4.5	321.0	73.63	0.94	
	1445.0	5.0	289.0	73.63	0.94	
	1446.0	6.0	241.0	73.63	0.94	
	1447.0	7.0	207.0	73.62	0.93	
	1448.0	8.0	181.0	73.61	0.92	
	1449.0	9.0	161.0	73.61	0.92	
	1450.0	10.0	145.0	73.61	0.92	
	1452.0	12.0	121.0	73.61	0.92	
	1454.0	14.0	104.0	73.60	0.91	
	1456.0	16.0	91.0	73.57	0.88	
	1458.0	18.0	81.0	73.56	0.87	
	1460.0	20.0	73.0	73.56	0.87	
	1465.0	25.0	59.0	73.53	0.84	
	1470.0	30.0	49.0	73.52	0.83	
	1480.0	40.0	37.0	73.49	0.80	
	1490.0	50.0	30.0	73.49	0.80	
	1500.0	60.0	25.0	73.47	0.78	
2:00 P.M.	1530.0	90.0	17.0	73.42	0.73	
	1590.0	150.0	10.6	73.38	0.69	
	1640.0	200.0	8.2	73.35	0.66	
4:40 P.M.	1690.0	250.0	6.8	73.33	0.64	

RECOVERY READINGS IN WELL NO. 5 AFTER PUMPING TEST

Date February 21, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well	
8:50 P.M.	1940.0	500.0	3.88	73.22	0.53	February 22, 1976 Pump pulled Incomplete recovery
1:00 A.M.	2190.0	750.0	2.92	73.17	0.48	
	2440.0	1000.0	2.44	73.14	0.45	
7:30 A.M.	2580.0	1140.0	2.26	73.03	0.34	
12:15 P.M.	2865.0	1425.0	2.01	72.99	0.30	

READINGS TAKEN ON OBSERVATION WELL NO. 1 DURING
PUMPING TEST ON WELL NO. 5

Date February 20, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Original Static Water Level 81.50' (Total Stickup 3.9')
				Static Level 77.6' below ground
2:30 P.M.	0.0	81.50		
	0.5	81.60	0.10	
	1.0	81.63	0.13	
	1.5	81.66	0.16	
	2.0	81.70	0.20	Pumping rate Q=678 U.S. gpm
	2.5	81.74	0.24	
	3.0	81.78	0.28	
	3.5	81.80	0.30	
	4.0	81.81	0.31	
	4.5	81.84	0.34	
	5.0	81.76	0.26	
	6.0	81.75	0.25	
	7.0	81.75	0.25	
	8.0	81.75	0.25	
	9.0	81.75	0.25	
12:40	10.0	81.76	0.26	
	12.0	81.77	0.27	
	14.0	81.77	0.27	
	16.0	81.77	0.27	
	18.0	81.78	0.28	
	20.0	81.78	0.28	
	25.0	81.78	0.28	
	30.0	81.79	0.29	
	35.0	81.79	0.29	
	40.0	81.80	0.30	
	45.0	81.81	0.31	
	50.0	81.81	0.31	
1:30	60.0	81.82	0.32	
	70.0	81.83	0.33	
	80.0	81.85	0.35	
2:00	90.0	81.86	0.36	
2:10	100.0	81.87	0.37	
3:00	150.0	81.91	0.41	
3:50	200.0	82.04	0.54	Pumping rate Q=1001 U.S. gpm
4:40	250.0	82.08	0.58	
5:30	300.0	82.12	0.62	

READINGS TAKEN ON OBSERVATION WELL NO. 1 DURING
PUMPING TEST ON WELL NO. 5

Date February 20, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	
6:20 P.M.	350.0	82.15	0.65	
7:10	400.0	82.17	0.67	
8:00	450.0	82.20	0.70	
8:50	500.0	82.23	0.73	
9:40	550.0	82.26	0.76	
10:30	600.0	82.28	0.78	
11:20	650.0	82.31	0.81	
12:10	700.0	82.33	0.83	February 21, 1976
1:00	750.0	82.36	0.86	
1:50	800.0	82.37	0.87	
2:40	850.0	82.39	0.89	
3:30	900.0	82.41	0.91	
4:20	950.0	82.43	0.93	
5:10	1000.0	82.45	0.95	
6:00	1050.0	82.46	0.96	
6:50	1100.0	82.48	0.98	
7:40	1150.0	82.50	1.00	
8:30	1200.0	82.52	1.02	
9:20	1250.0	82.54	1.04	
10:10	1300.0	82.55	1.05	
11:00	1350.0	82.55	1.05	
11:50	1400.0	82.56	1.06	
12:30	1440.0	82.56	1.06	Pump shut off Data abstracted from hydrograph chart.

RECOVERY READINGS ON OBSERVATION WELL NO. 1 AFTER
PUMPING TEST ON WELL NO. 5

Date February 21, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well	
12:30 P.M.	1440.0	0.0	--	82.57	1.07	
		0.5	2881.0	82.47	0.97	
		1.0	1441.0	82.37	0.87	
		1.5	961.0	82.36	0.86	
		2.0	721.0	82.34	0.84	
		2.5	577.0	82.32	0.82	
		3.0	481.0	82.30	0.80	
		3.5	412.43	82.28	0.78	
		4.0	361.0	82.26	0.76	
		4.5	321.0	82.25	0.75	
		5.0	289.0	82.25	0.75	
		6.0	241.0	82.25	0.75	
		7.0	206.71	82.25	0.75	
		8.0	181.0	82.24	0.74	
		9.0	161.0	82.23	0.73	
2:40	1450.0	10.0	145.0	82.23	0.73	
		12.0	121.0	82.23	0.73	
		14.0	103.86	82.22	0.72	
		16.0	91.0	82.22	0.72	
		18.0	81.0	82.21	0.71	
	1460.0	20.0	73.0	82.20	0.70	
		25.0	58.6	82.19	0.69	
1:00	1470.0	30.0	49.0	82.18	0.68	
		35.0	42.14	82.17	0.67	
	1480.0	40.0	37.0	82.16	0.66	
		45.0	33.0	82.16	0.66	
	1490.0	50.0	29.8	82.15	0.65	
1:30	1500.0	60.0	25.0	82.14	0.64	
	1510.0	70.0	21.57	82.13	0.63	
	1520.0	80.0	19.0	82.13	0.63	
2:00	1530.0	90.0	17.0	82.12	0.62	
	1540.0	100.0	15.4	82.11	0.61	
3:00	1590.0	150.0	10.6	82.08	0.58	
	1640.0	200.0	8.2	82.05	0.55	
4:40	1690.0	250.0	6.76	82.01	0.51	

RECOVERY READINGS ON OBSERVATION WELL NO. 1 AFTER
PUMPING TEST ON WELL NO. 5

Date February 21, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well	
5:30 P.M.	1740.0	300.0	5.8	81.99	0.49	February 22, 1976
6:20	1790.0	350.0	5.11	81.96	0.46	
7:10	1840.0	400.0	4.60	81.95	0.45	
8:00	1890.0	450.0	4.2	81.94	0.44	
8:50	1940.0	500.0	3.88	81.92	0.42	
9:40	1990.0	550.0	3.62	81.91	0.41	
10:30	2040.0	600.0	3.40	81.89	0.39	
11:20	2090.0	650.0	3.22	81.88	0.38	
12:10 A.M.	2140.0	700.0	3.06	81.87	0.37	
1:00	2190.0	750.0	2.92	81.84	0.34	
1:50	2240.0	800.0	2.80	81.83	0.33	
2:40	2290.0	850.0	2.70	81.82	0.32	
3:30	2340.0	900.0	2.60	81.81	0.31	
4:20	2390.0	950.0	2.51	81.80	0.30	
5:10	2440.0	1000.0	2.44	81.80	0.30	
6:00	2490.0	1050.0	2.37	81.79	0.29	
6:50	2540.0	1100.0	2.31	81.78	0.28	
7:40	2590.0	1150.0	2.25	81.77	0.27	
8:30	2640.0	1200.0	2.20	81.77	0.27	
9:20	2690.0	1250.0	2.15	81.76	0.26	
10:10	2740.0	1300.0	2.10	81.75	0.25	
11:00	2790.0	1350.0	2.07	81.74	0.24	Incomplete recovery Data abstracted from hydrograph chart.
1:50	2840.0	1400.0	2.03	81.73	0.23	

READINGS TAKEN ON OBSERVATION WELL NO. 4 DURING
PUMPING TEST ON WELL NO. 5

Date February 20, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 77.73)	Stick up 1.61' Static 76.12' below ground
12:30 P.M.	0.0	77.73	0.0	Pumping rate Q=678 U.S. gpm
	0.5	77.93	0.20	
	1.0	78.06	0.33	
	1.5	78.10	0.37	
	2.0	78.13	0.40	
	2.5	78.12	0.39	
	3.0	78.03	0.30	
	3.5	78.02	0.29	
	4.0	78.02	0.29	
	4.5	78.02	0.29	
	5.0	78.02	0.29	
	6.0	78.02	0.29	
	7.0	78.02	0.29	
	8.0	78.02	0.29	
	9.0	78.02	0.29	
2:40	10.0	78.02	0.29	
	12.0	78.03	0.30	
	14.0	78.03	0.30	
	16.0	78.04	0.31	
	18.0	78.04	0.31	
12:50	20.0	78.04	0.31	Pumping rate Q=1001 U.S. gpm
	25.0	78.06	0.33	
1:00	30.0	78.07	0.34	
	35.0	78.08	0.35	
	40.0	78.09	0.36	
	45.0	78.09	0.36	
	50.0	78.10	0.37	
	55.0	78.10	0.37	
1:30	60.0	78.11	0.38	
	70.0	78.12	0.39	
	80.0	78.13	0.40	
2:00	90.0	78.14	0.41	
2:10	100.0	78.15	0.42	
3:00	150.0	78.19	0.46	
3:50	200.0	78.35	0.62	
4:40	250.0	78.39	0.66	

READINGS TAKEN ON OBSERVATION WELL NO. 4 DURING
PUMPING TEST ON WELL NO. 5

Date February 20, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	
5:30 P.M.	300.0	78.44	0.71	
6:20	350.0	78.47	0.74	
7:10	400.0	78.50	0.77	
8:00	450.0	78.54	0.81	
8:50	500.0	78.58	0.85	
9:40	550.0	78.60	0.87	
10:30	600.0	78.63	0.90	
1:20	650.0	78.66	0.93	
2:10 A.M.	700.0	78.69	0.96	February 21, 1976
1:00	750.0	78.71	0.98	
1:50	800.0	78.74	1.01	
2:40	850.0	78.76	1.03	
3:30	900.0	78.77	1.04	
4:20	950.0	78.79	1.06	
5:10	1000.0	78.83	1.10	
6:00	1050.0	78.84	1.11	
6:50	1100.0	78.86	1.13	
7:40	1150.0	78.88	1.15	
8:30	1200.0	78.89	1.16	
9:20	1250.0	78.91	1.18	
10:10	1300.0	78.92	1.19	
11:00	1350.0	78.94	1.21	
11:50	1400.0	78.95	1.22	
12:30 P.M.	1440.0	78.96	1.23	Pump shut off Data abstracted from hydrograph chart.

RECOVERY READINGS ON OBSERVATION WELL NO. 4 AFTER
PUMPING TEST ON WELL NO. 5

Date February 21, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well	
12:30 P.M.	1440.0	0.0	--	78.96	1.23	
	1440.5	0.5	2881.0	78.68	0.95	
	1441.0	1.0	1441.0	78.63	0.90	
	1441.5	1.5	961.0	78.62	0.89	
	1442.0	2.0	721.0	78.61	0.88	
	1442.5	2.5	577.0	78.61	0.88	
	1443.0	3.0	481.0	78.61	0.88	
	1443.5	3.5	412.43	78.61	0.88	
	1444.0	4.0	361.0	78.61	0.88	
	1444.5	4.5	321.0	78.60	0.87	
	1445.0	5.0	289.0	78.60	0.87	
	1446.0	6.0	241.0	78.59	0.86	
	1447.0	7.0	206.71	78.59	0.86	
	1448.0	8.0	181.0	78.59	0.86	
	1449.0	9.0	161.0	78.58	0.85	
2:40	1450.0	10.0	145.0	78.58	0.85	
	1452.0	12.0	121.0	78.57	0.84	
	1454.0	14.0	103.86	78.57	0.84	
	1456.0	16.0	91.0	78.56	0.83	
	1458.0	18.0	81.0	78.55	0.82	
12:50	1460.0	20.0	73.0	78.55	0.82	
	1465.0	25.0	58.6	78.54	0.81	
1:00	1470.0	30.0	49.0	78.52	0.79	
1:05	1475.0	35.0	42.14	78.50	0.77	
1:10	1480.0	40.0	37.0	78.49	0.76	
1:15	1485.0	45.0	33.0	78.49	0.76	
1:20	1490.0	50.0	29.8	78.48	0.75	
1:30	1500.0	60.0	25.0	78.47	0.74	
1:40	1510.0	70.0	21.57	78.45	0.72	
1:50	1520.0	80.0	19.0	78.44	0.71	
2:00	1530.0	90.0	17.0	78.43	0.70	
2:10	1540.0	100.0	15.4	78.42	0.69	
3:00	1590.0	150.0	10.6	78.38	0.65	
3:50	1640.0	200.0	8.2	78.34	0.61	

RECOVERY READINGS ON OBSERVATION WELL NO. 4 AFTER
PUMPING TEST ON WELL NO. 5

Date February 21, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well	
4:40 P.M.	1690.0	250.0	6.76	78.30	0.57	February 22, 1976
5:30	1740.0	300.0	5.8	78.27	0.54	
6:20	1790.0	350.0	5.11	78.25	0.52	
7:10	1840.0	400.0	4.60	78.24	0.51	
8:00	1890.0	450.0	4.2	78.21	0.48	
8:50	1940.0	500.0	3.88	78.19	0.46	
9:40	1990.0	550.0	3.62	78.17	0.44	
10:30	2040.0	600.0	3.40	78.16	0.43	
11:20	2090.0	650.0	3.22	78.15	0.42	
12:10 A.M.	2140.0	700.0	3.06	78.15	0.42	
1:00	2190.0	750.0	2.92	78.14	0.41	
1:50	2240.0	800.0	2.80	78.12	0.39	
2:40	2290.0	850.0	2.70	78.11	0.38	
3:30	2340.0	900.0	2.60	78.10	0.37	
4:20	2390.0	950.0	2.51	78.09	0.36	
5:10	2440.0	1000.0	2.44	78.08	0.35	
6:00	2490.0	1050.0	2.37	78.07	0.34	
6:50	2540.0	1100.0	2.31	78.05	0.32	
7:40	2590.0	1150.0	2.25	78.04	0.31	
8:30	2640.0	1200.0	2.20	78.03	0.30	
9:20	2690.0	1250.0	2.15	78.02	0.29	Incomplete recovery Data abstracted from hydrograph chart.
10:10	2740.0	1300.0	2.10	78.01	0.28	
11:00	2790.0	1350.0	2.07	78.01	0.28	
11:50	2840.0	1400.0	2.03	78.00	0.27	
12:30 P.M.	2880.0	1440.0	2.0	78.00	0.27	

READINGS TAKEN ON OBSERVATION WELL NO. 6 DURING
PUMPING TEST ON WELL NO. 5

Date February 20, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Stick up 1.2 feet Static 67.92 feet below ground
12:30 P.M.	0.0	69.12	0.0	Pumping rate Q=678 U.S. gpm
	0.5	69.43	0.31	
	1.0	69.48	0.36	
	1.5	69.49	0.37	
	2.0	69.48	0.36	
	2.5	69.42	0.30	
	3.0	69.39	0.27	
	3.5	69.38	0.26	
	4.0	69.38	0.26	
	4.5	69.38	0.26	
	5.0	69.38	0.26	
	6.0	69.37	0.25	
	7.0	69.37	0.25	
	8.0	69.37	0.25	
	9.0	69.37	0.25	
	10.0	69.37	0.25	
	12.0	69.38	0.26	
	14.0	69.38	0.26	
	16.0	69.39	0.27	
	18.0	69.40	0.28	
	20.0	69.41	0.29	
	25.0	69.42	0.30	Pumping rate Q=1001 U.S. gpm
	30.0	69.42	0.30	
	35.0	69.44	0.32	
	40.0	69.44	0.32	
	50.0	69.45	0.33	
	60.0	69.47	0.35	
	80.0	69.49	0.37	
	100.0	69.51	0.39	
	150.0	69.55	0.43	
	160.0	69.65	0.53	
	170.0	69.67	0.55	
3:30 P.M.	180.0	69.69	0.57	
	190.0	69.70	0.58	
	200.0	69.71	0.59	

READINGS TAKEN ON OBSERVATION WELL NO. 6 DURING
PUMPING TEST ON WELL NO. 5

Date February 20, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	
5:30 P.M.	250.0 275.0 300.0 350.0 400.0 450.0 500.0 600.0 700.0 800.0 900.0	69.75 69.77 69.79 69.83 69.86 69.89 69.92 69.97 70.01 70.05 70.08	0.63 0.65 0.67 0.71 0.74 0.77 0.80 0.85 0.89 0.93 0.96	
5:10 A.M.	1000.0 1100.0 1200.0 1300.0 1440.0	70.12 70.15 70.18 70.20 70.23	1.00 1.03 1.06 1.08 1.11	February 21, 1976
2:30 P.M. 21 Feb.				Pump shut off Data abstracted from hydrograph chart.

RECOVERY READINGS ON OBSERVATION WELL NO. 6 AFTER
PUMPING TEST ON WELL NO. 5

Date February 21, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well	
2:30 P.M.	1440.0	0.0	--	70.23	1.11	
	1440.5	0.5	2881.0	70.07	0.95	
	1441.0	1.0	1441.0	69.95	0.83	
	1441.5	1.5	961.0	69.92	0.80	
	1442.0	2.0	721.0	69.90	0.78	
	1442.5	2.5	577.0	69.90	0.78	
	1443.0	3.0	481.0	69.89	0.77	
	1443.5	3.5	412.4	69.89	0.77	
	1444.0	4.0	361.0	69.89	0.77	
	1444.5	4.5	321.0	69.89	0.77	
	1445.0	5.0	289.0	69.88	0.76	
	1446.0	6.0	241.0	69.88	0.76	
	1447.0	7.0	207.0	69.87	0.75	
	1448.0	8.0	181.0	69.87	0.75	
	1449.0	9.0	161.0	69.86	0.74	
	1450.0	10.0	145.0	69.86	0.74	
	1452.0	12.0	121.0	69.85	0.73	
	1454.0	14.0	104.0	69.84	0.72	
	1456.0	16.0	91.0	69.84	0.72	
	1458.0	18.0	81.0	69.83	0.71	
	1460.0	20.0	73.0	69.82	0.70	
	1465.0	25.0	59.0	69.81	0.69	
1:00 P.M.	1470.0	30.0	49.0	69.80	0.68	
	1480.0	40.0	37.0	69.78	0.66	
	1490.0	50.0	30.0	69.76	0.64	
	1540.0	100.0	15.0	69.70	0.58	
	1590.0	150.0	10.0	69.66	0.54	
	1640.0	200.0	8.2	69.63	0.51	
	1690.0	250.0	6.76	69.58	0.46	
5:30 P.M.	1740.0	300.0	5.8	69.56	0.44	
	1790.0	350.0	5.1	69.54	0.42	
	1840.0	400.0	4.6	69.52	0.40	
	1890.0	450.0	4.2	69.50	0.38	
	1940.0	500.0	3.88	69.49	0.37	

RECOVERY READINGS ON OBSERVATION WELL NO. 6 AFTER
PUMPING TEST ON WELL NO. 5

Date February 21, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well	
10:30 P.M.	2040.0	600.0	3.4	69.46	0.34	Data abstracted from hydrograph chart. Recorder removed and installed on well No. 5. Pump installed in this well (No. 6). Incomplete recovery
	2140.0	700.0	3.0	69.43	0.31	
	2240.0	800.0	2.8	69.40	0.28	
	2340.0	900.0	2.6	69.38	0.26	
	2440.0	1000.0	2.4	69.37	0.25	
6:50 A.M.	2540.0	1100.0	2.3	69.35	0.23	
22. Feb.						
2:30 P.M.	2880.0	1440.0	2.0	69.20	0.08	

"CONSTANT RATE" PUMPING TEST DATA FROM WELL NO. 6

Date February 22, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 69.20)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	
						Stick up 1.2'
2:30 P.M.	0.0	69.20	0.0			Static 68.0' below ground
	0.5	88.41	19.21			Measurements made with
	1.0	88.00	18.80			M-scope
	1.5	88.07	18.87	20.5	945.0	
	2.0	88.05	18.85			
	2.5	87.86	18.66			
	3.0	89.11	19.91			
	3.5	89.52	20.32			
	4.0	90.27	21.07			
	4.5	90.49	21.29	23.5	1012.0	
	5.0	90.52	21.32			
	6.0	90.50	21.30			
	7.0	90.53	21.33			
	8.0	90.52	21.32			
	9.0	90.54	21.34			
	10.0	90.56	21.36			
	12.0	90.58	21.38			
	14.0	90.57	21.37			
	16.0	90.57	21.37			
	18.0	90.58	21.38			
	20.0	90.59	21.39			
	25.0	90.62	21.42			
	30.0	90.63	21.43			
	35.0					
	40.0	90.66	21.46			
	45.0					
	50.0	90.68	21.48			
	60.0					
	75.0	90.74	21.54			
2:10 P.M.	100.0	90.80	21.60			
	150.0	90.88	21.68			
3:50 P.M.	200.0	90.93	21.73			

"CONSTANT RATE" PUMPING TEST DATA FROM WELL NO. 6

Date February 22, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 69.20)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	
	350.0	91.03	21.83	23.5	1012.0	
	450.0	91.20	22.00			
	550.0	91.15	21.95			
6:30 P.M.	660.0	91.19	21.99			
7:30 A.M.	1140.0	91.30	22.10			February 23, 1976
8:10 A.M.	1240.0	91.29	22.09			
9:50 A.M.	1340.0	91.40	22.20			
12:30 P.M.	1440.0	91.39	22.19			Pump shut off

RECOVERY READINGS IN WELL NO. 6 AFTER
"CONSTANT RATE" PUMPING TEST

Date February 23, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well in feet (static = 69.20)	
2:30 P.M.	1440.0	0.0	.	91.39	22.19	Measurements made with, M-scope
		0.5	2882.0	68.79	-0.41	
		1.0	1441.0	69.04	-0.16	
		1.5	961.0	69.03	-0.17	
		2.0	721.0	69.30	0.10	
		2.5	577.0	69.66	0.46	
		3.0	481.0	69.87	0.67	
		3.5	412.0	69.97	0.77	
		4.0	361.0	70.05	0.85	
		4.5	321.0	69.96	0.76	
		5.0	289.0	69.94	0.74	
		6.0	241.0	69.94	0.74	
		7.0	207.0	69.94	0.74	
		8.0	181.0	69.93	0.73	
		9.0	161.0	69.93	0.73	
		10.0	145.0	69.93	0.73	
		12.0	121.0	69.90	0.70	
		14.0	104.0	69.90	0.70	
		16.0	91.0	69.89	0.69	
		18.0	81.0	69.89	0.69	
		20.0	73.0	69.89	0.69	
		25.0	59.0	69.86	0.66	Pump pulled
1:00 P.M.		30.0	49.0	69.85	0.65	
	1480.0	40.0	37.0	69.80	0.60	
		50.0	30.0	69.78	0.58	
2:00 P.M.	1530.0	90.0	17.0	69.70	0.50	February 24, 1976
4:45 P.M.	1695.0	255.0	6.6	69.66	0.46	
6:05 P.M.	1775.0	335.0	5.3	69.59	0.39	
11:00 A.M.	2790.0	1350.0	2.06	69.34	0.14	

READINGS TAKEN ON OBSERVATION WELL NO. 1 DURING
"CONSTANT RATE" PUMPING TEST ON WELL NO. 6

Date February 22, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 81.73)	
12:30 P.M.	0.0	81.73	0.00	Reading from previous chart
	0.5	81.74	.01	
	1.0	81.75	.02	
	1.5	81.75	.02	
	2.0	81.76	.03	
	2.5	81.76	.03	
	3.0	81.76	.03	
	3.5	81.77	.04	
	4.0	81.77	.04	
	4.5	81.78	.05	
	5.0	81.78	.05	
	6.0	81.78	.05	
	7.0	81.78	.05	
	8.0	81.79	.06	
	9.0	81.79	.06	
	10.0	81.79	.06	
	12.0	81.79	.06	
	14.0	81.80	.07	
	16.0	81.80	.07	
	18.0	81.80	.07	
	20.0	81.81	.08	
	25.0	81.81	.08	
	30.0	81.81	.08	
	35.0	81.82	.09	
	40.0	81.82	.09	
	45.0	81.83	.10	
	50.0	81.83	.10	
1:30 P.M.	60.0	81.84	.11	
	80.0	81.85	.12	
	100.0	81.86	.13	
	150.0	81.91	.18	
3:50 P.M.	200.0	81.94	.21	

READINGS TAKEN ON OBSERVATION WELL NO. 1 DURING
"CONSTANT RATE" PUMPING TEST ON WELL NO. 6

Date February 22, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 81.73)
	250.0	81.96	.23
5:30 P.M.	300.0	81.98	.25
	350.0	82.01	.28
	400.0	82.03	.30
	450.0	82.04	.31
	500.0	82.06	.33
10:30 P.M.	600.0	82.09	.36
12:10 A.M.	700.0	82.11	.38
	800.0	82.14	.41
	900.0	82.15	.42
	1000.0	82.17	.44
	1200.0	82.21	.48
2:30 P.M.	1440.0	82.22	.49

February 23, 1976

Data abstracted from hydrograph chart

RECOVERY READINGS ON OBSERVATION WELL NO. 1 AFTER
CONSTANT RATE PUMPING TEST ON WELL NO. 6

Date February 23, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well in feet (static = 81.73)	
12:30 P.M.	1440.0	0.0		82.22	0.49	Data abstracted from hydrograph chart
	1440.5	0.5	2882.0	82.22	0.49	
	1441.0	1.0	1441.0	82.21	0.48	
	1441.5	1.5	961.0	82.20	0.47	
	1442.0	2.0	721.0	82.19	0.46	
	1442.5	2.5	577.0	82.18	0.45	
	1443.0	3.0	481.0	82.18	0.45	
	1443.5	3.5	412.0	82.17	0.44	
	1444.0	4.0	361.0	82.17	0.44	
	1444.5	4.5	321.0	82.17	0.44	
	1445.0	5.0	289.0	82.17	0.44	
	1446.0	6.0	241.0	82.16	0.43	
	1447.0	7.0	207.0	82.16	0.43	
	1448.0	8.0	181.0	82.16	0.43	
	1449.0	9.0	161.0	82.16	0.43	
2:40 P.M.	1450.0	10.0	145.0	82.16	0.43	
	1452.0	12.0	121.0	82.16	0.43	
	1454.0	14.0	104.0	82.15	0.42	
	1456.0	16.0	91.0	82.15	0.42	
	1458.0	18.0	81.0	82.15	0.42	
	1460.0	20.0	73.0	82.15	0.42	
	1465.0	25.0	59.0	82.15	0.42	
	1470.0	30.0	49.0	82.14	0.41	
	1475.0	35.0	42.0	82.14	0.41	
	1480.0	40.0	37.0	82.14	0.41	
	1485.0	45.0	33.0	82.13	0.40	
	1490.0	50.0	30.0	82.13	0.40	
1:30 P.M.	1500.0	60.0	25.0	82.12	0.39	
	1520.0	80.0	19.0	82.10	0.37	
	1540.0	100.0	15.0	82.09	0.36	
	1590.0	150.0	10.0	82.07	0.34	
3:50 P.M.	1640.0	200.0	8.0	82.04	0.31	

RECOVERY READINGS ON OBSERVATION WELL NO. 1 AFTER
CONSTANT RATE PUMPING TEST ON WELL NO. 6

Date February 23, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well in feet (static = 81.73)	
	1690.0	250.0	6.8	82.02	0.29	
	1740.0	300.0	5.8	82.00	0.27	
	1790.0	350.0	5.1	81.99	0.26	
7:10 P.M.	1840.0	400.0	4.6	81.97	0.24	
	1890.0	450.0	4.2	81.96	0.23	
	1940.0	500.0	3.9	81.95	0.22	
	2040.0	600.0	3.4	81.93	0.20	
2:10 A.M.	2140.0	700.0	3.0	81.91	0.18	February 24, 1976
	2240.0	800.0	2.8	81.89	0.16	
	2340.0	900.0	2.6	81.87	0.14	
	2440.0	1000.0	2.4	81.86	0.13	
8:30 A.M.	2640.0	1200.0	2.2	81.82	0.09	Recorder removed
Data abstracted from monthly hydrograph chart						
5:00 P.M.	3150.0	1710.0	1.84	81.72		February 25, 1976
1:00 A.M.	3630.0	2190.0	1.66	81.67		
9:00 A.M.	4110.0	2670.0	1.54	81.65		
5:00 P.M.	4590.0	3150.0	1.46	81.64		February 26, 1976
1:00 A.M.	5070.0	3630.0	1.40	81.61		
9:00 A.M.	5550.0	4110.0	1.35	81.60		
5:00 P.M.	6030.0	4590.0	1.31	81.60		February 27, 1976

READINGS TAKEN ON OBSERVATION WELL NO. 4 DURING
"CONSTANT RATE" PUMPING TEST ON WELL NO. 6

Date February 22, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 77.99)	
2:30 P.M.	0.0	77.99	0.00	
	0.5	78.00	0.01	
	1.0	78.01	0.02	
	1.5	78.02	0.03	
	2.0	78.02	0.03	
	2.5	78.02	0.03	
	3.0	78.02	0.03	
	3.5	78.02	0.03	
	4.0	78.03	0.04	
	4.5	78.03	0.04	
	5.0	78.03	0.04	
	6.0	78.03	0.04	
	7.0	78.03	0.04	
	8.0	78.04	0.05	
	9.0	78.04	0.05	
	10.0	78.04	0.05	
	12.0	78.05	0.06	
	14.0	78.05	0.06	
	16.0	78.05	0.06	
	18.0	78.06	0.07	
	20.0	78.06	0.07	
	25.0	78.06	0.07	
	30.0	78.07	0.08	
	35.0	78.08	0.09	
	40.0	78.08	0.09	
	45.0	78.10	0.11	
	50.0	78.10	0.11	
	60.0	78.11	0.12	
	80.0	78.13	0.14	
2:10 P.M.	100.0	78.14	0.15	
	150.0	78.17	0.18	
3:50 P.M.	200.0	78.22	0.23	

READINGS TAKEN ON OBSERVATION WELL NO. 4 DURING
"CONSTANT RATE" PUMPING TEST ON WELL NO. 6

Date February 22, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 77.99)	
5:30 P.M.	250.0	78.25	0.26	
	300.0	78.28	0.29	
	350.0	78.30	0.31	
	400.0	78.31	0.32	
	450.0	78.33	0.34	
	500.0	78.37	0.38	
	600.0	78.39	0.40	
	700.0	78.41	0.42	February 23, 1976
	800.0	78.44	0.45	
	900.0	78.46	0.47	
	1000.0	78.49	0.50	
	1200.0	78.53	0.54	
2:30 P.M.	1440.0	78.54	0.55	Data abstracted from hydrograph chart

RECOVERY READINGS ON OBSERVATION WELL NO. 4 AFTER
CONSTANT RATE PUMPING TEST ON WELL NO.6

Date February 23, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well in feet (static = 77.99)	
2:30 P.M.	1440.0	0.0		78.54	0.55	Reading from previous chart
	1440.5	0.5	2882.0	78.53	0.54	
	1441.0	1.0	1441.0	78.52	0.53	
	1441.5	1.5	961.0	78.50	0.51	
	1442.0	2.0	721.0	78.50	0.51	
	1442.5	2.5	577.0	78.49	0.50	
	1443.0	3.0	481.0	78.49	0.50	
	1443.5	3.5	412.0	78.49	0.50	
	1444.0	4.0	361.0	78.49	0.50	
	1444.5	4.5	321.0	78.48	0.49	
	1445.0	5.0	289.0	78.48	0.49	
	1446.0	6.0	241.0	78.48	0.49	
	1447.0	7.0	207.0	78.48	0.49	
	1448.0	8.0	181.0	78.48	0.49	
	1449.0	9.0	161.0	78.48	0.49	
	1450.0	10.0	145.0	78.48	0.49	
	1452.0	12.0	121.0	78.47	0.48	
	1454.0	14.0	104.0	78.47	0.48	
	1456.0	16.0	91.0	78.47	0.48	
	1458.0	18.0	81.0	78.47	0.48	
	1460.0	20.0	73.0	78.47	0.48	Data abstracted from hydrograph chart
	1465.0	25.0	59.0	78.46	0.47	
	1470.0	30.0	49.0	78.45	0.46	
	1475.0	35.0	42.0	78.45	0.46	
	1480.0	40.0	37.0	78.44	0.45	
	1485.0	45.0	33.0	78.44	0.45	
	1490.0	50.0	30.0	78.43	0.44	
1:30 P.M.	1500.0	60.0	25.0	78.42	0.43	
	1520.0	80.0	19.0	78.40	0.41	
	1540.0	100.0	15.0	78.39	0.40	
	1590.0	150.0	10.0	78.37	0.38	
3:50 P.M.	1640.0	200.0	8.0	78.34	0.35	

RECOVERY READINGS ON OBSERVATION WELL NO. 4 AFTER
CONSTANT RATE PUMPING TEST ON WELL NO. 6

Date February 23, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well in feet (static = 77.99)	
5:30 P.M.	1690.0 1740.0	250.0 300.0	6.8 5.8	78.30 78.29	0.31 0.30	Removed recorder and lid welded on M-scope reading
1:00 A.M. Feb. 24	2790.0	1350.0	2.1	77.92	-0.07	

READINGS TAKEN ON OBSERVATION WELL NO. 5 DURING
"CONSTANT RATE" PUMPING TEST ON WELL NO. 6

Date February 22, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 72.98)	No. 5 well is still recovering from pumping test No. 5
12:30 P.M.	0.0	72.98	0.0	
	0.5	73.22	0.24	
	1.0	73.24	0.26	
	1.5	73.25	0.27	
	2.0	73.27	0.29	
	2.5	73.29	0.31	
	3.0	73.30	0.32	
	3.5	73.30	0.32	
	4.0	73.31	0.33	
	4.5	73.32	0.34	
	5.0	73.32	0.34	
	6.0	73.32	0.34	
	7.0	73.33	0.35	
	8.0	73.33	0.35	
	9.0	73.34	0.36	
	10.0	73.34	0.36	
	12.0	73.35	0.37	
	14.0	73.36	0.38	
	16.0	73.37	0.39	
	18.0	73.38	0.40	
	20.0	73.39	0.41	
	25.0	73.40	0.42	
	30.0	73.42	0.44	
	35.0	73.43	0.45	
	40.0	73.44	0.46	
	45.0	73.45	0.47	
	50.0	73.46	0.48	
	60.0	73.47	0.49	
	80.0	73.51	0.53	
2:10 P.M.	100.0	73.52	0.54	
	150.0	73.60	0.62	
	200.0	73.64	0.66	
	250.0	73.68	0.70	
5:30 P.M.	300.0	73.72	0.74	
	350.0	73.75	0.77	
	400.0	73.77	0.79	

READINGS TAKEN ON OBSERVATION WELL NO. 5 DURING
"CONSTANT RATE" PUMPING TEST ON WELL NO. 6

Date February 22, 1976

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static = 72.98)	
8:00 P.M.	450.0	73.80	0.82	February 23, 1976
	500.0	73.82	0.84	
	600.0	73.85	0.87	
12:10 P.M.	700.0	73.86	0.88	
	800.0	73.89	0.91	
	900.0	73.91	0.93	
	1000.0	73.94	0.96	
	1100.0	73.96	0.98	
	1200.0	73.97	0.99	
	1300.0	73.97	0.99	
12:30 P.M.	1440.0	73.99	1.01	
				Pump shut off Data abstracted from hydrograph chart

RECOVERY READINGS ON OBSERVATION WELL NO. 5 AFTER
CONSTANT RATE PUMPING TEST ON WELL NO. 6

Date February 23, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well in feet (static = 72.98)	
2:30 P.M.	1440.0	0.0		73.99	1.01	
	1440.5	0.5	2882.0	73.85	0.87	
	1441.0	1.0	1441.0	73.72	0.74	
	1441.5	1.5	961.0	73.68	0.70	
	1442.0	2.0	721.0	73.66	0.68	
	1442.5	2.5	577.0	73.66	0.68	
	1443.0	3.0	481.0	73.66	0.68	
	1443.5	3.5	412.4	73.65	0.67	
	1444.0	4.0	361.0	73.65	0.67	
	1444.5	4.5	321.0	73.65	0.67	
	1445.0	5.0	289.0	73.65	0.67	
	1446.0	6.0	241.0	73.64	0.66	
	1447.0	7.0	207.0	73.63	0.65	
	1448.0	8.0	181.0	73.63	0.65	
	1449.0	9.0	161.0	73.63	0.65	
12:40 P.M.	1450.0	10.0	145.0	73.62	0.64	
	1452.0	12.0	121.0	73.61	0.63	
	1454.0	14.0	104.0	73.61	0.63	
	1456.0	16.0	91.0	73.60	0.62	
	1458.0	18.0	81.0	73.60	0.62	
	1460.0	20.0	73.0	73.59	0.61	
	1465.0	25.0	59.0	73.58	0.60	
	1470.0	30.0	49.0	73.57	0.59	
	1475.0	35.0	42.0	73.56	0.58	
	1480.0	40.0	37.0	73.55	0.57	
	1485.0	45.0	33.0	73.54	0.56	
	1490.0	50.0	30.0	73.53	0.55	
3:30 P.M.	1500.0	60.0	25.0	73.50	0.52	
	1510.0	70.0	21.6	73.48	0.50	
	1520.0	80.0	19.0	73.47	0.49	
	1530.0	90.0	17.0	73.46	0.48	
	1540.0	100.0	15.4	73.45	0.47	
	1590.0	150.0	10.6	73.40	0.42	
3:50 P.M.	1640.0	200.0	8.2	73.36	0.38	

Data abstracted from
hydrograph chart

RECOVERY READINGS ON OBSERVATION WELL NO. 5 AFTER
CONSTANT RATE PUMPING TEST ON WELL NO. 6

Date February 23, 1976

	Time (t) since start of pumping	Time (t') since pumping stopped	Value of t/t'	Depth to water in well from top of casing	Residual drawdown in well in feet (static = 72.98)	
4:40 P.M.	1690.0	250.0	6.7	73.32	0.34	
	1740.0	300.0	5.8	73.30	0.32	
	1790.0	350.0	5.1	73.28	0.30	
	1840.0	400.0	4.6	73.26	0.28	
	1890.0	450.0	4.2	73.23	0.25	
	1940.0	500.0	3.9	73.21	0.23	
	2040.0	600.0	3.4	73.18	0.20	
12:10 A.M.	2140.0	700.0	3.0	73.15	0.17	February 24, 1976
	2240.0	800.0	2.8	73.13	0.15	
	2340.0	900.0	2.6	73.10	0.12	
	2440.0	1000.0	2.4	73.09	0.11	
	2640.0	1200.0	2.2	73.05	0.07	Recorder removed
1:00 A.M.	2790.0	1350.0	2.1	73.06	0.08	M-scope measurement incomplete recovery

APPENDIX C

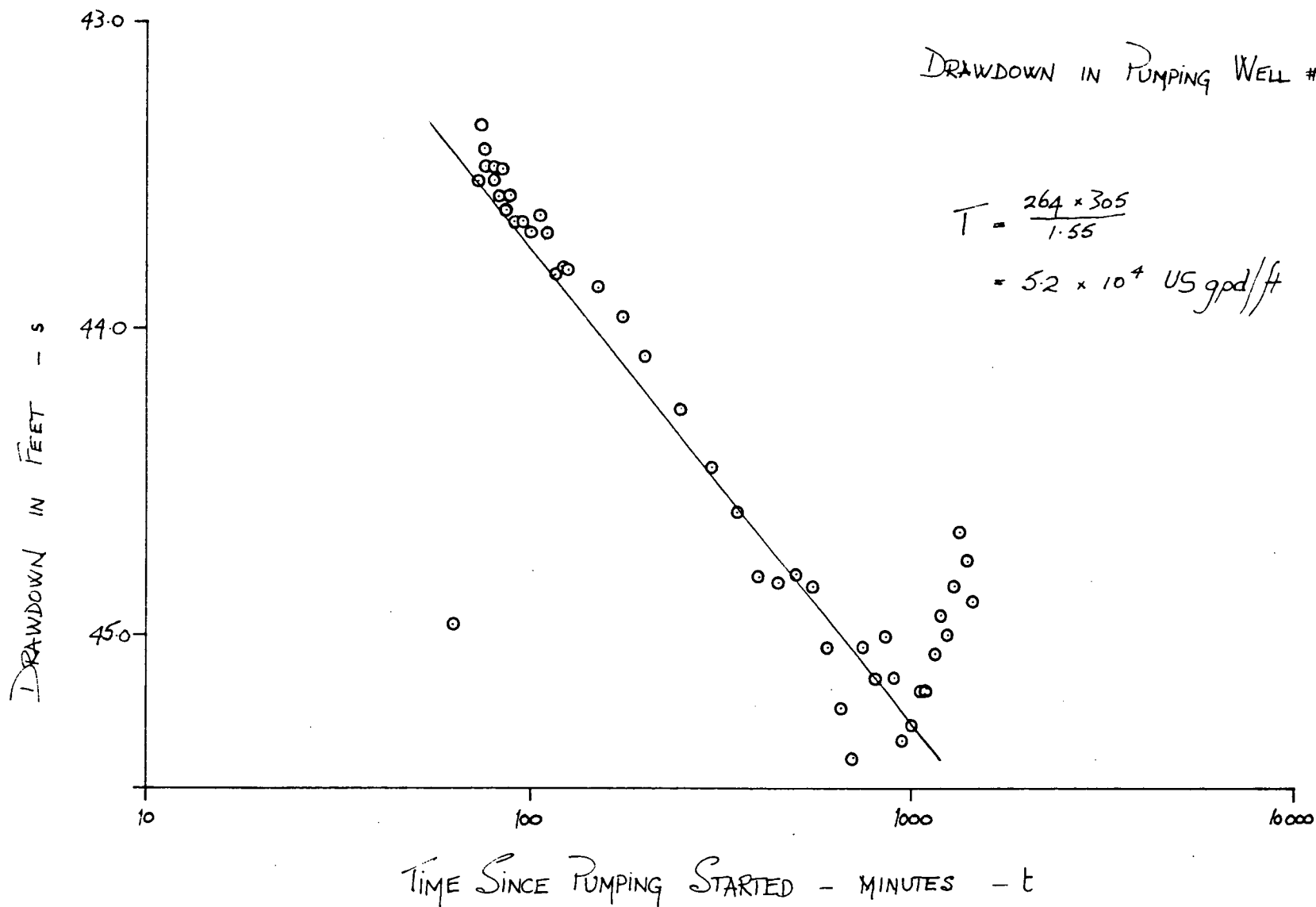
GRAPHICAL ANALYSIS OF

PUMPING TEST DATA

SITE #1

APPENDIX C

WELL #1	Drawdown Recovery Drawdown during re-test
WELL #4	Drawdown Recovery Drawdown - observation well #1 Recovery - observation well #1 Distance-drawdown
WELL #5	Drawdown Recovery Drawdown - Observation well #1 Recovery - Observation well #1 Drawdown - Observation well #4 Recovery - Observation well #4 Drawdown - Observation well #6 Recovery - Observation well #6 Log-log drawdown - observation well #1 Log-log drawdown - observation well #4 Log-log drawdown - observation well #6 Distance-drawdown
WELL #6	Drawdown Recovery Drawdown - observation well #1 Recovery - observation well #1 Drawdown - observation well #4 Recovery - observation well #4 Drawdown - observation well #6 Recovery - observation well #6 Log-log drawdown - observation well #1 Log-log drawdown - observation well #4 Log-log drawdown - observation well #5 Distance-drawdown



BRITISH COLUMBIA
 DEPARTMENT OF ENVIRONMENT
 WATER RESOURCES SERVICE
 WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.....

HOR.....

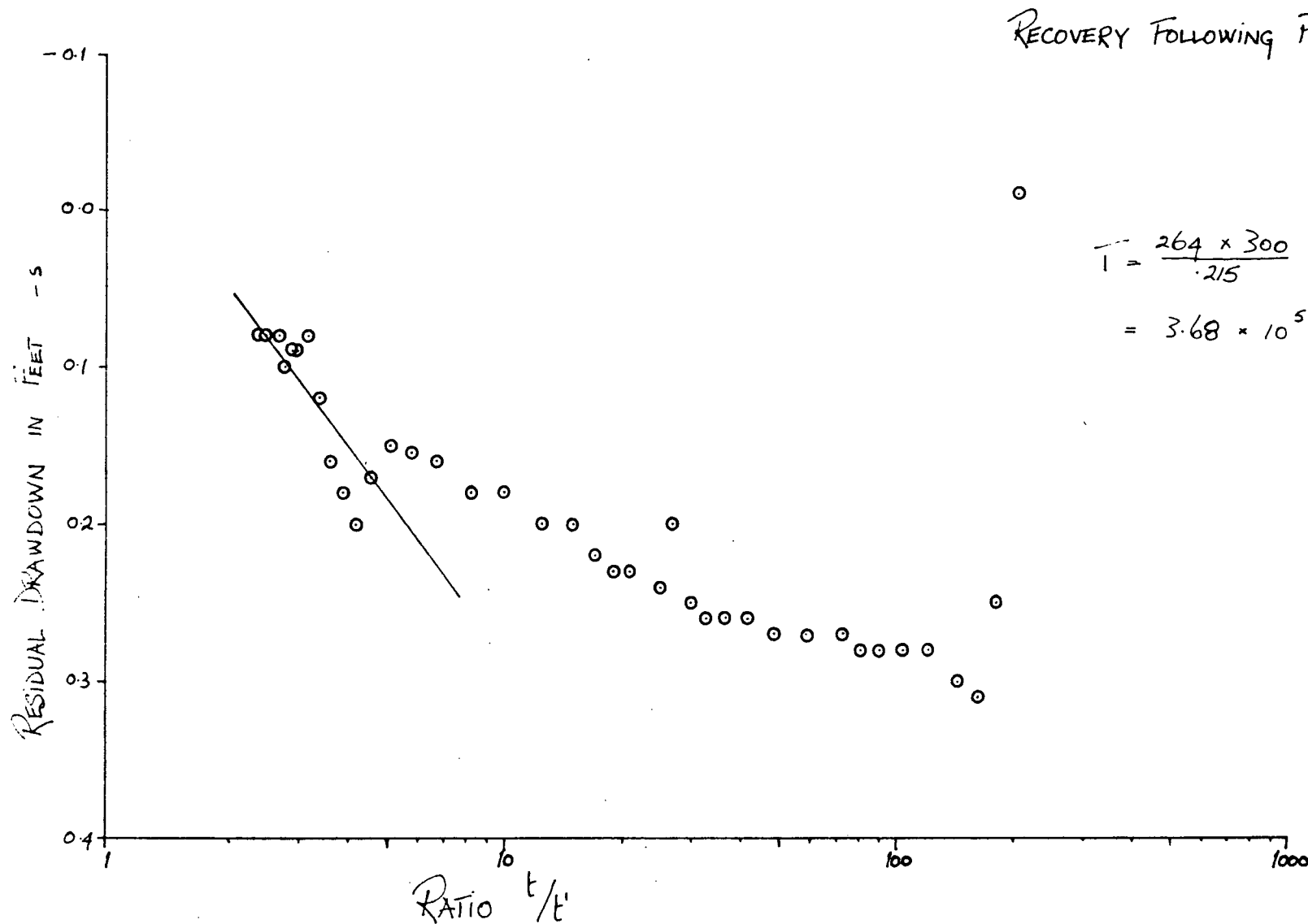
J. M. PETRIE

DATE

ENGINEER

FILE No. 0249723-A

DWG. No.



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WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

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SCALE: VERT.

HOR.

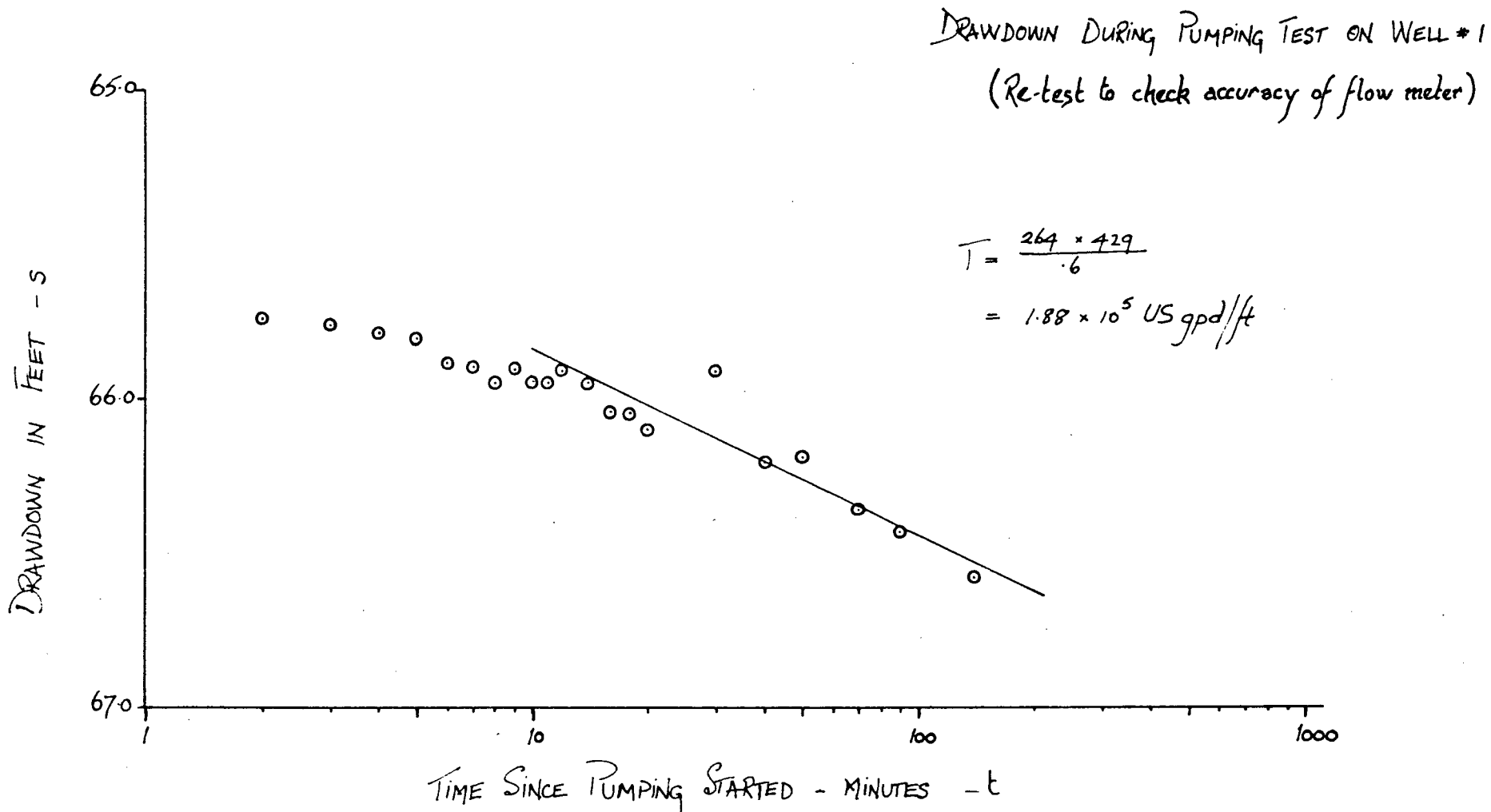
J. M. PETRIE

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ENGINEER

FILE No. 0249723 - A

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WATER RESOURCES SERVICE
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SCALE: VERT.....

HOR.....

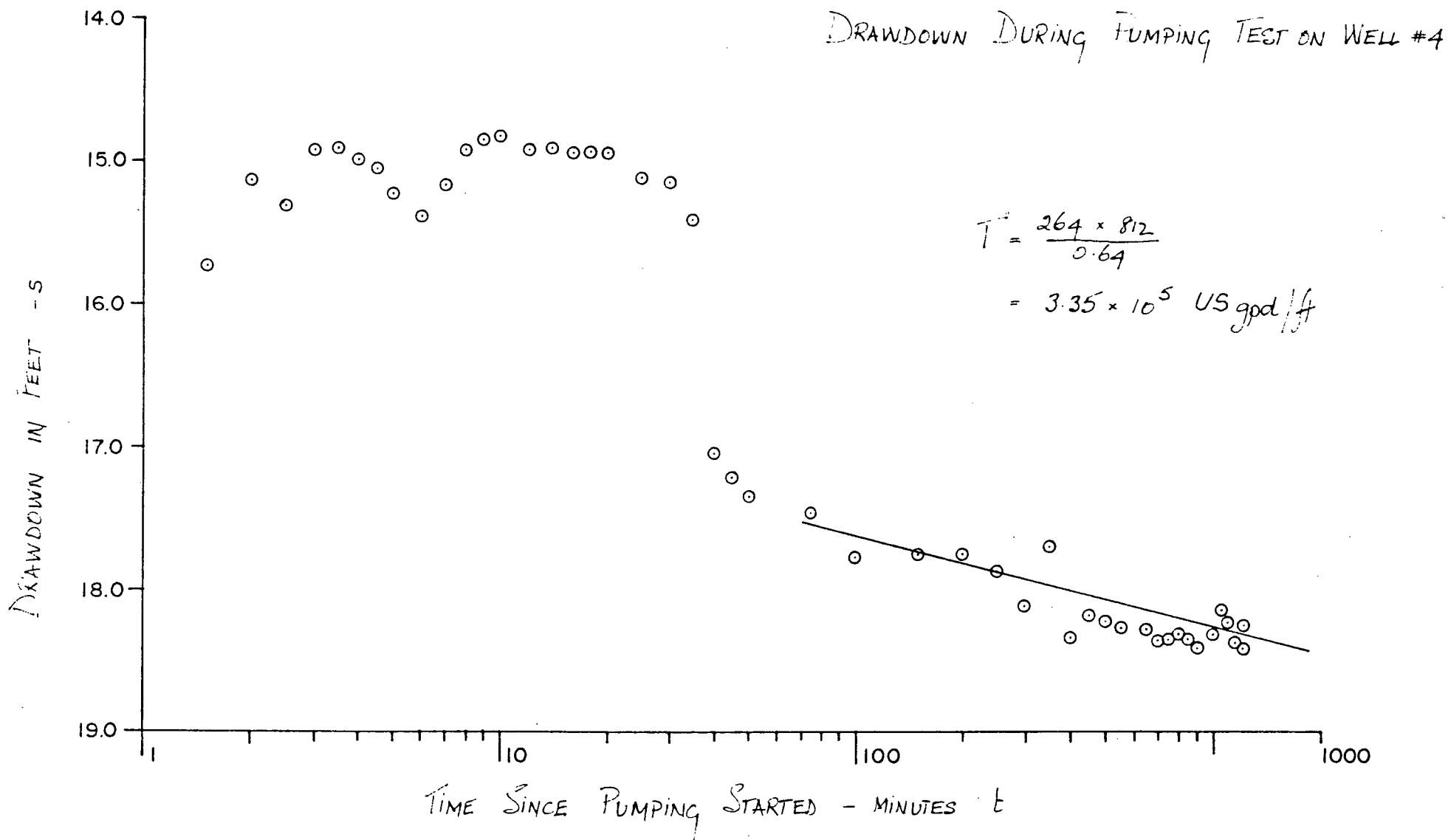
J. M. PETRIE

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WATER RESOURCES SERVICE
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TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.

HOR.

J. M. PETRIE

DATE

ENGINEER

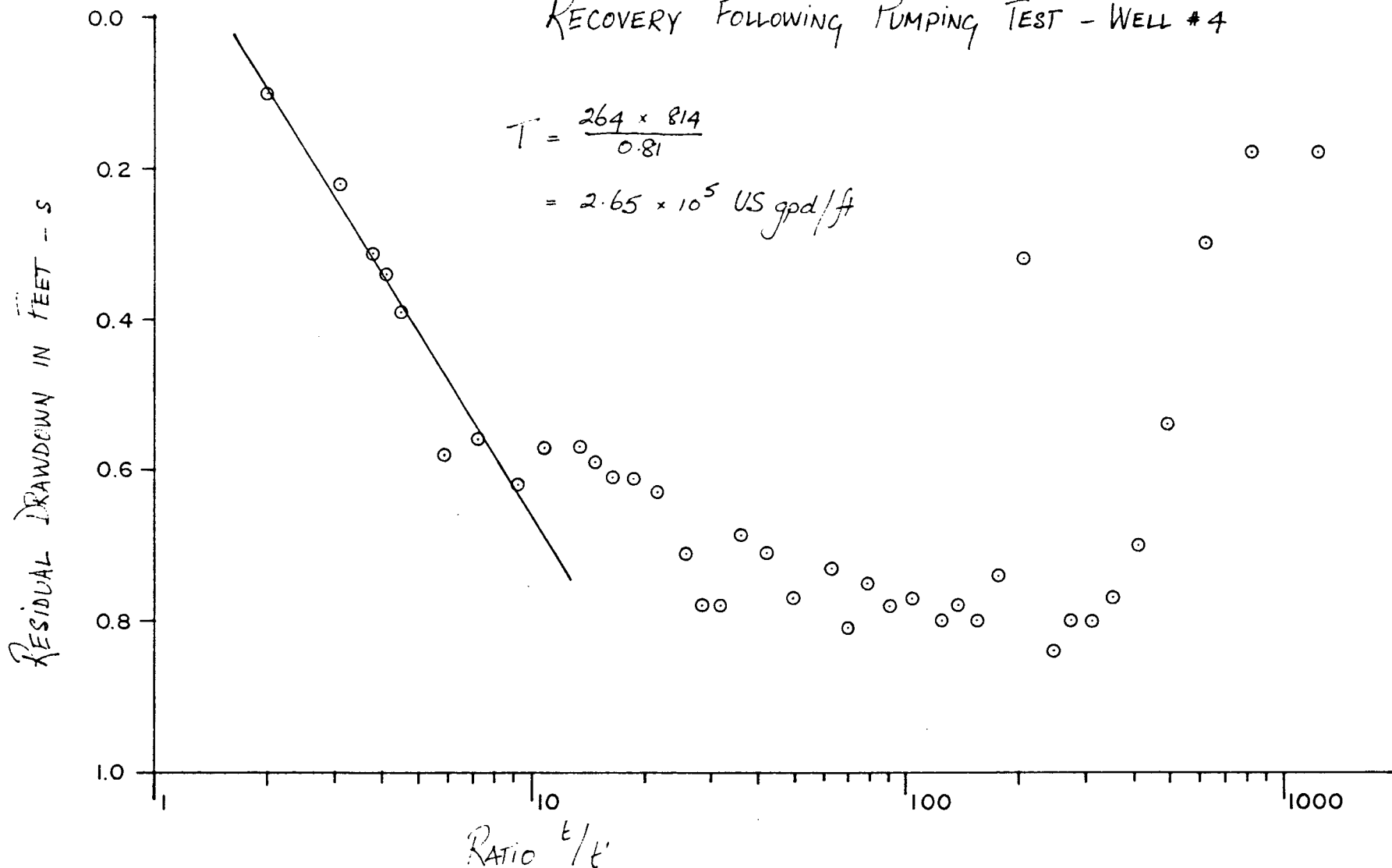
FILE No. 0249723 -A

DWG. No.

RECOVERY FOLLOWING PUMPING TEST - WELL #4

$$T = \frac{264 \times 814}{0.81}$$

$$= 2.65 \times 10^5 \text{ US gpd/ft}$$



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SCALE: VERT.

HOR.

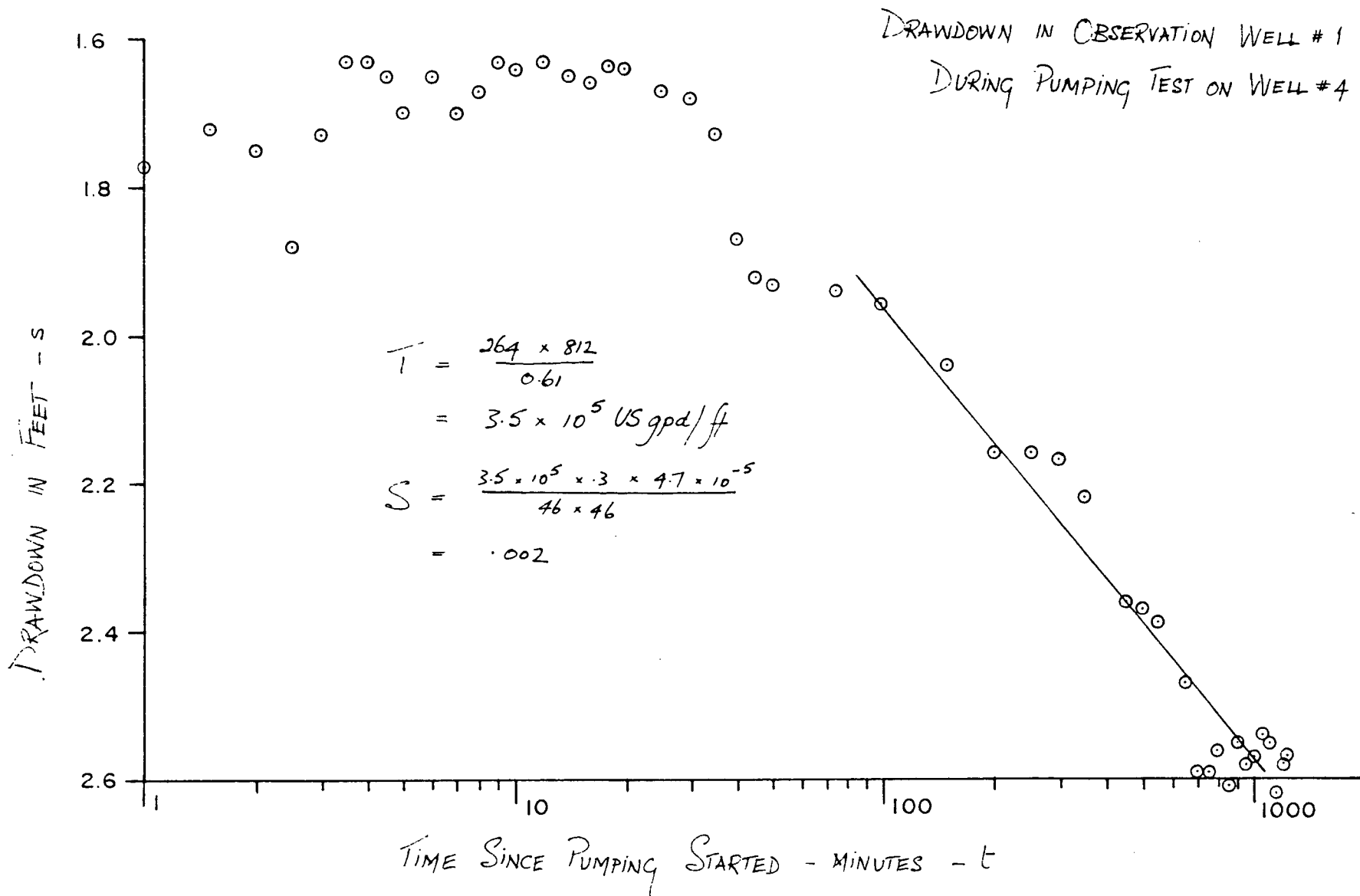
J.M. PETRIE

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ENGINEER

FILE No. 0249123 - A

DWG. No.



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WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.

HOR.

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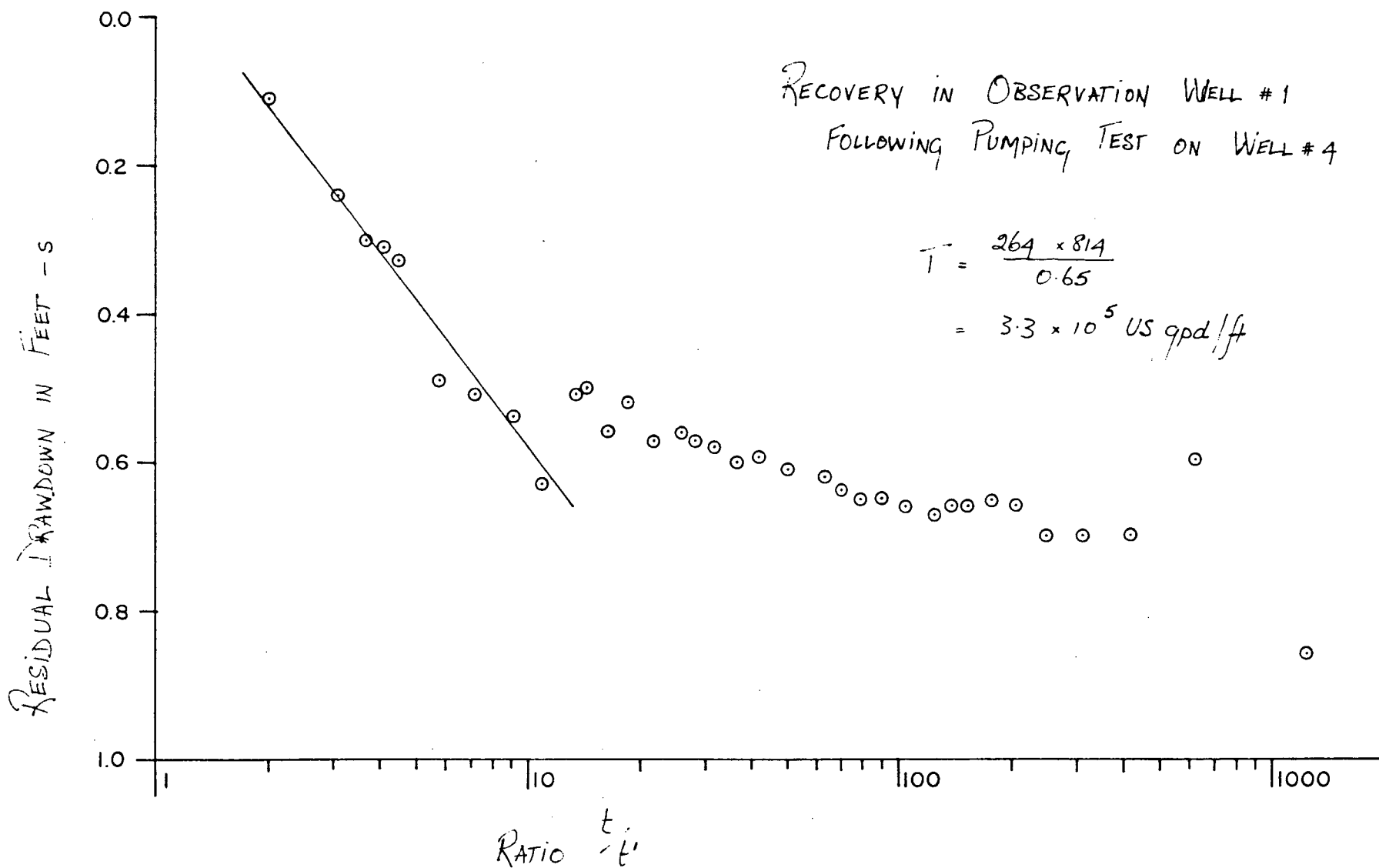
DATE

ENGINEER

FILE No.

0249723 - A

DWG. No.



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DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.

HOR.

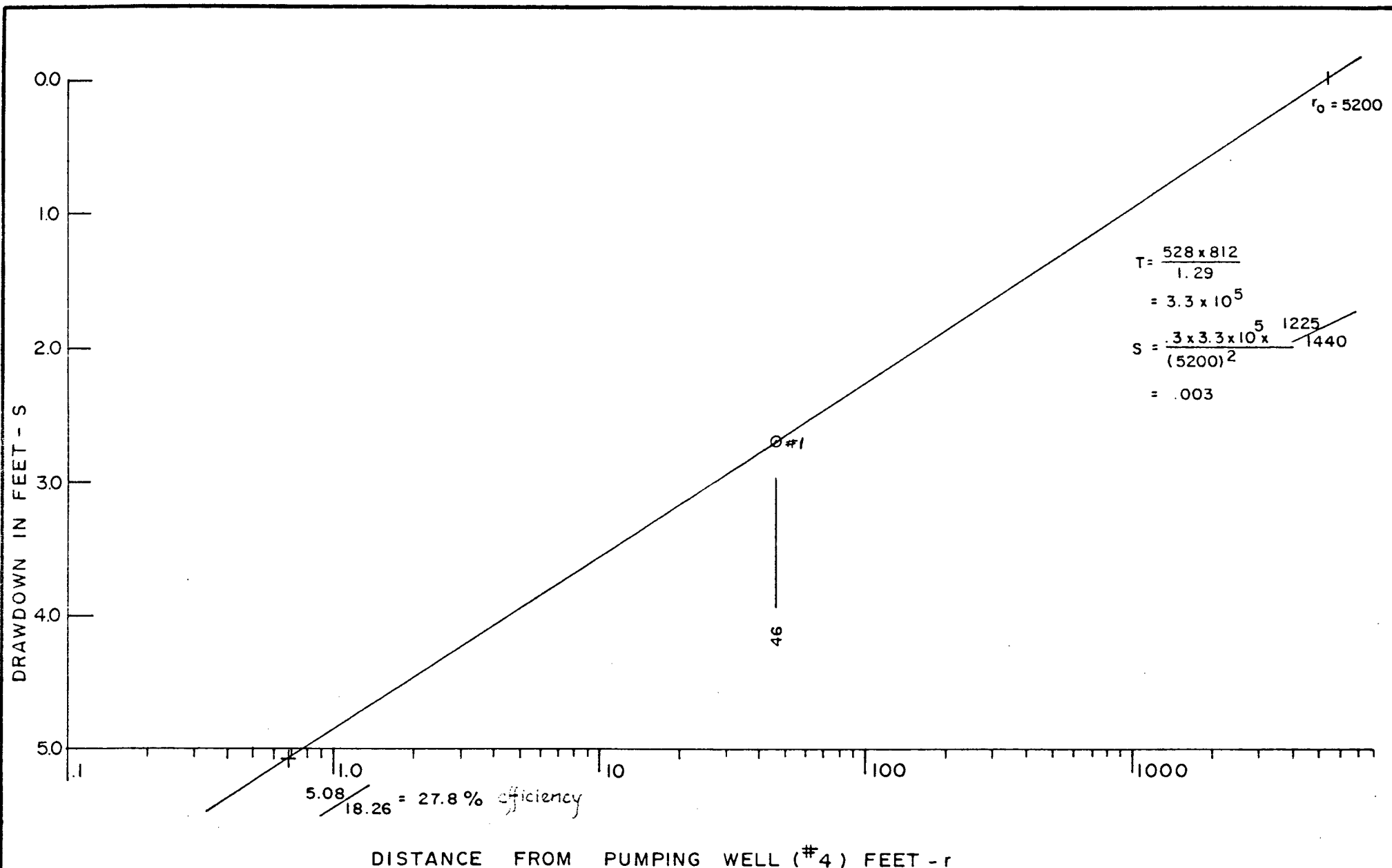
J. M. PETRIE

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FILE No. 0249723 -4

DWG. No.



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TO ACCOMPANY REPORT ON
FAIRVIEW HEIGHTS IRRIGATION DISTRICT
DISTANCE DRAWDOWN GRAPH
FOR PUMPING WELL # 4

SCALE: VERT.

HOR. N.T.S.

DATE

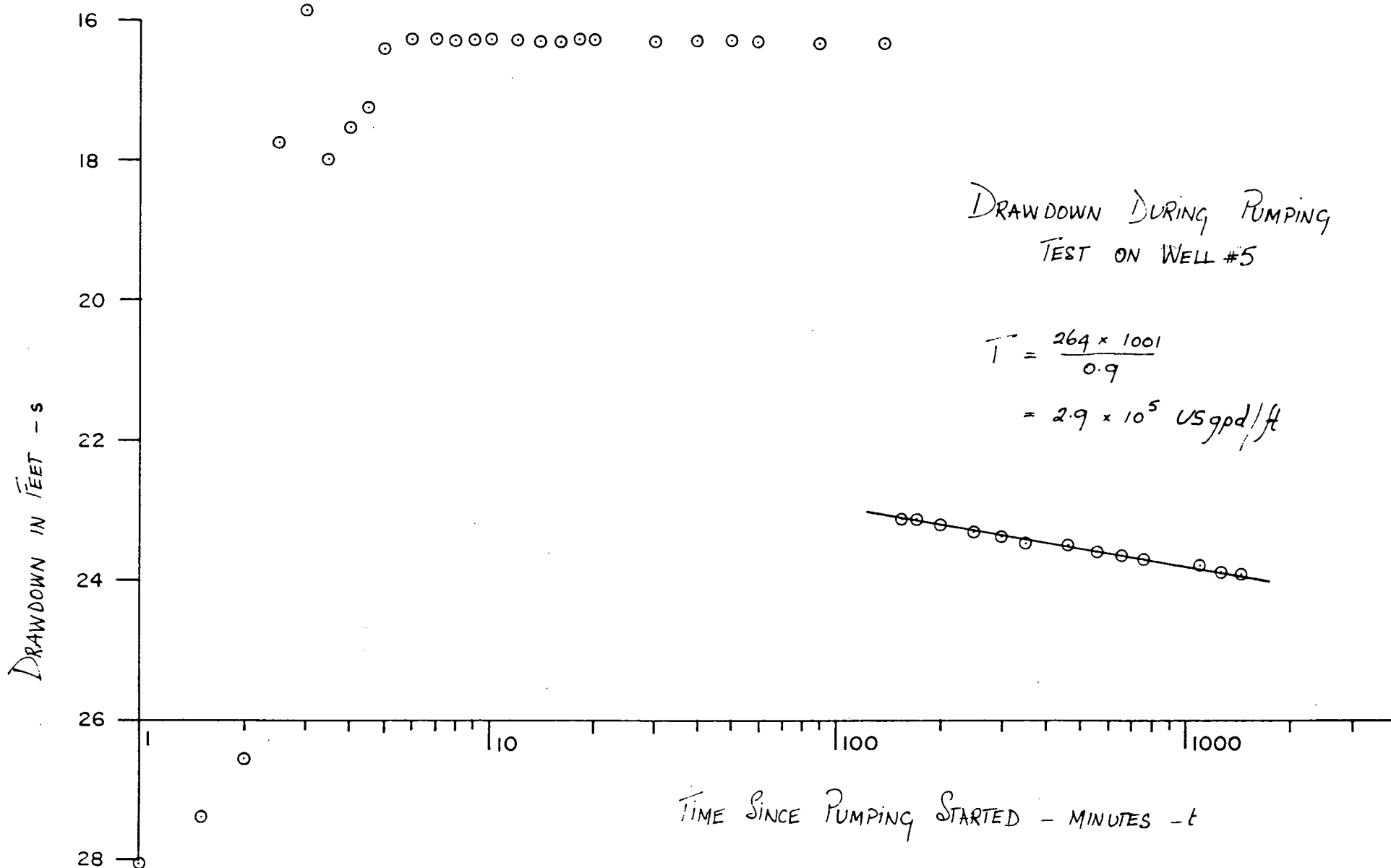
DEC. 1976

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FILE No. 0249723

DWG. No. 0249723 - A



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WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.

HOR.

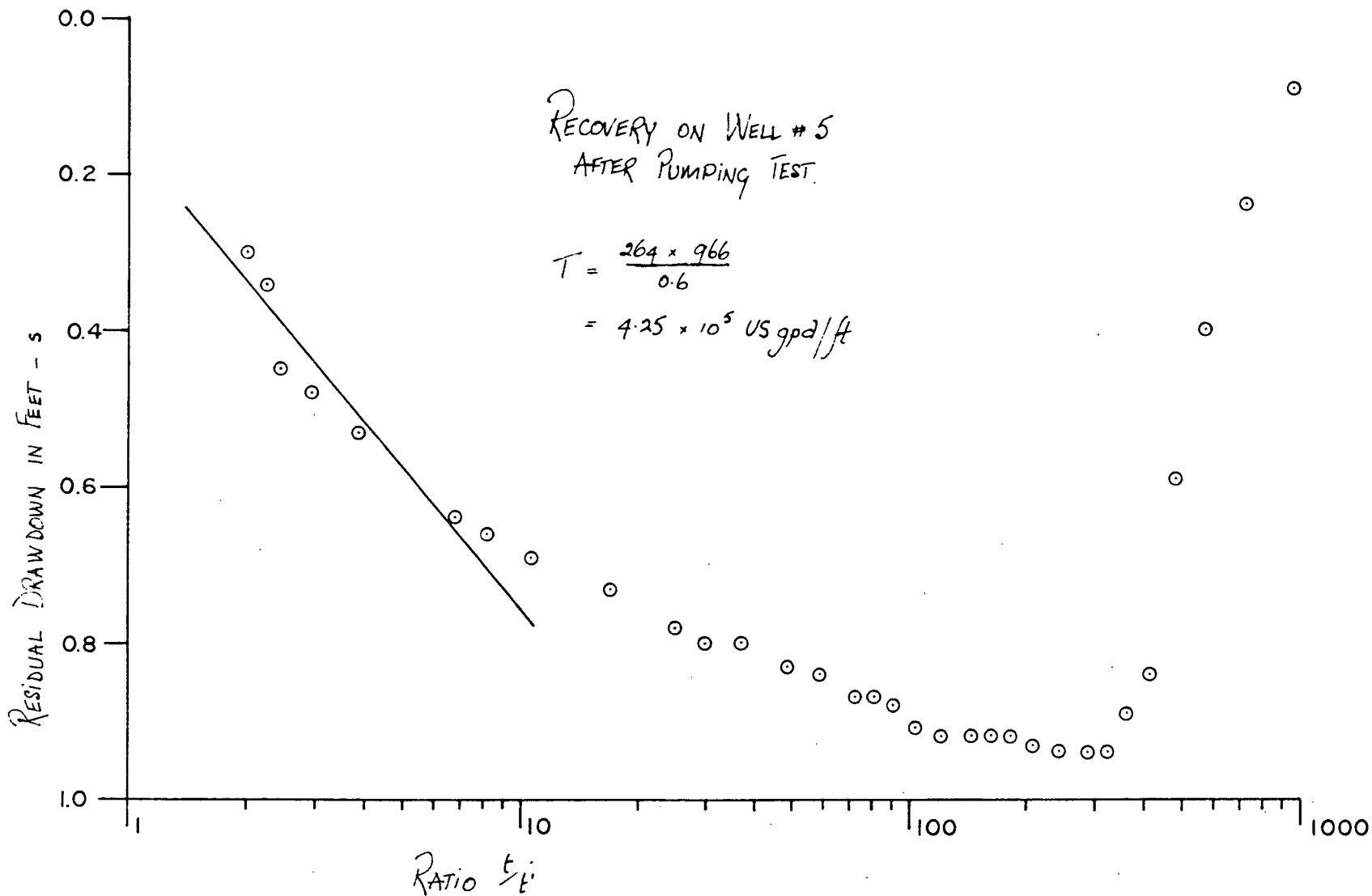
J. M. PETRIE

DATE

ENGINEER

FILE No. 0249723-A

DWG. No.



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FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.

HOR.

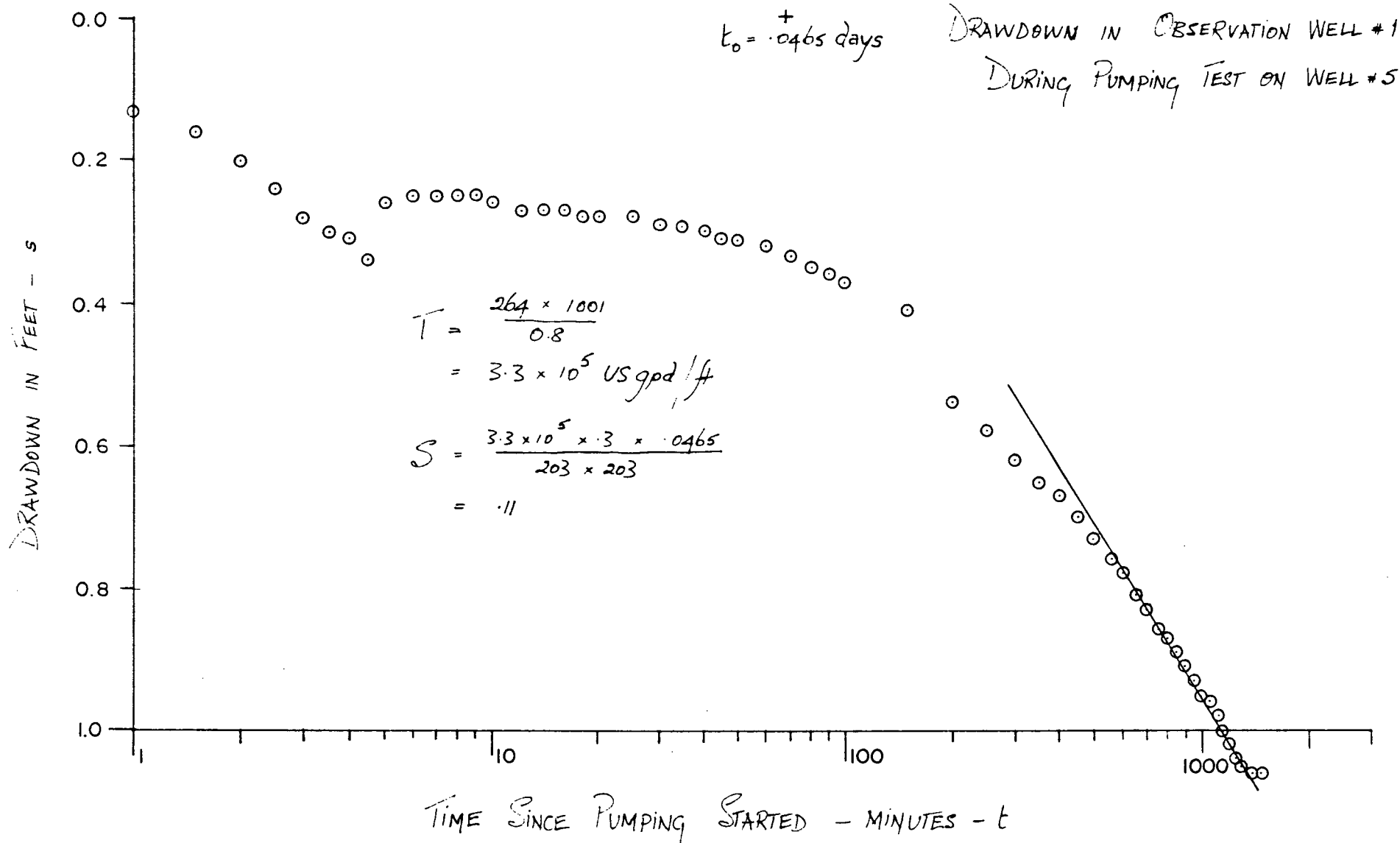
J. M. PETRIE

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FILE No. 0249723-A

DWG. No.



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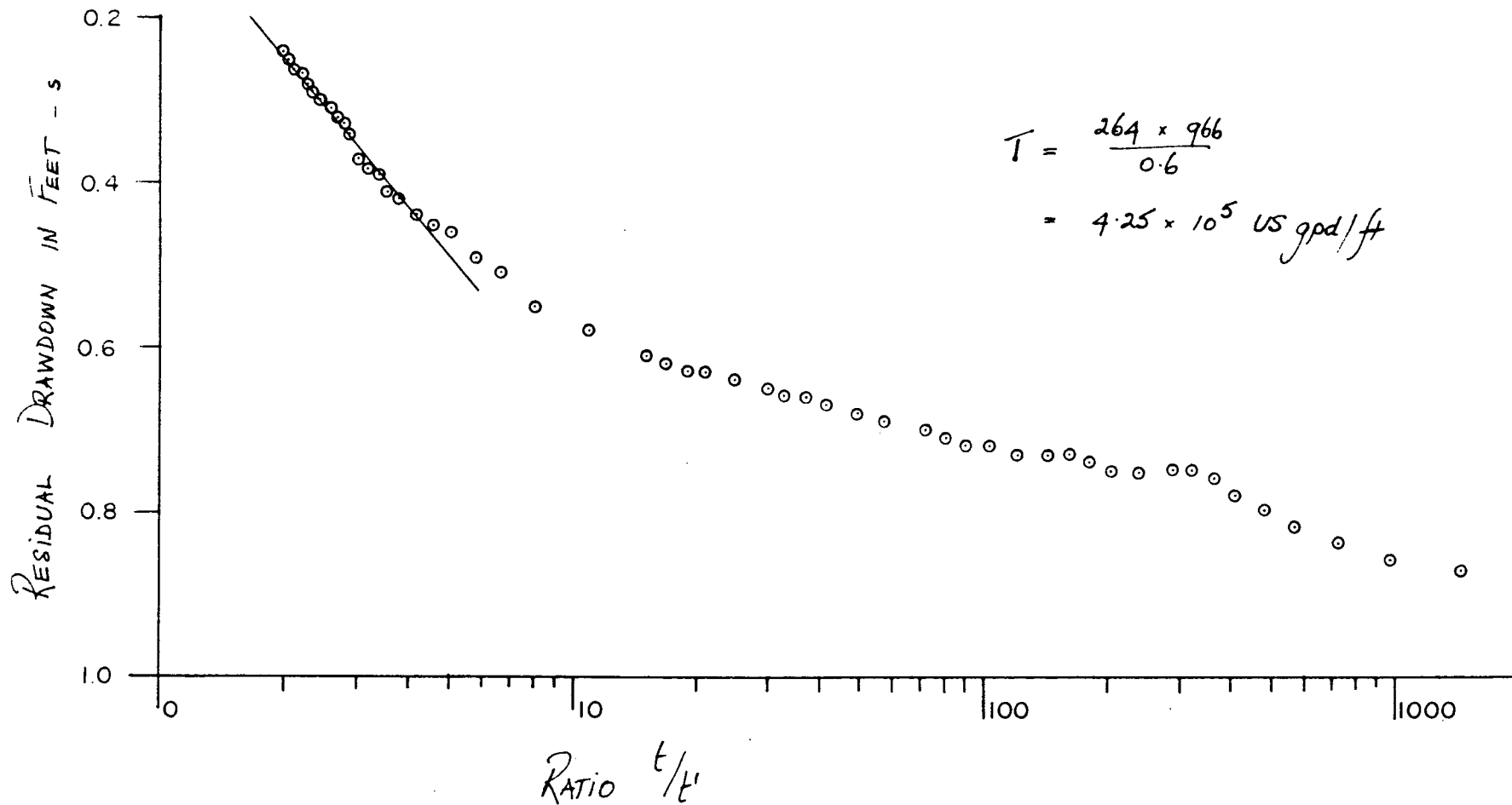
J. M. PETRIE

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FILE No. 0249723 -1

DWG. No.



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WATER INVESTIGATIONS BRANCH

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SCALE: VERT.

HOR.

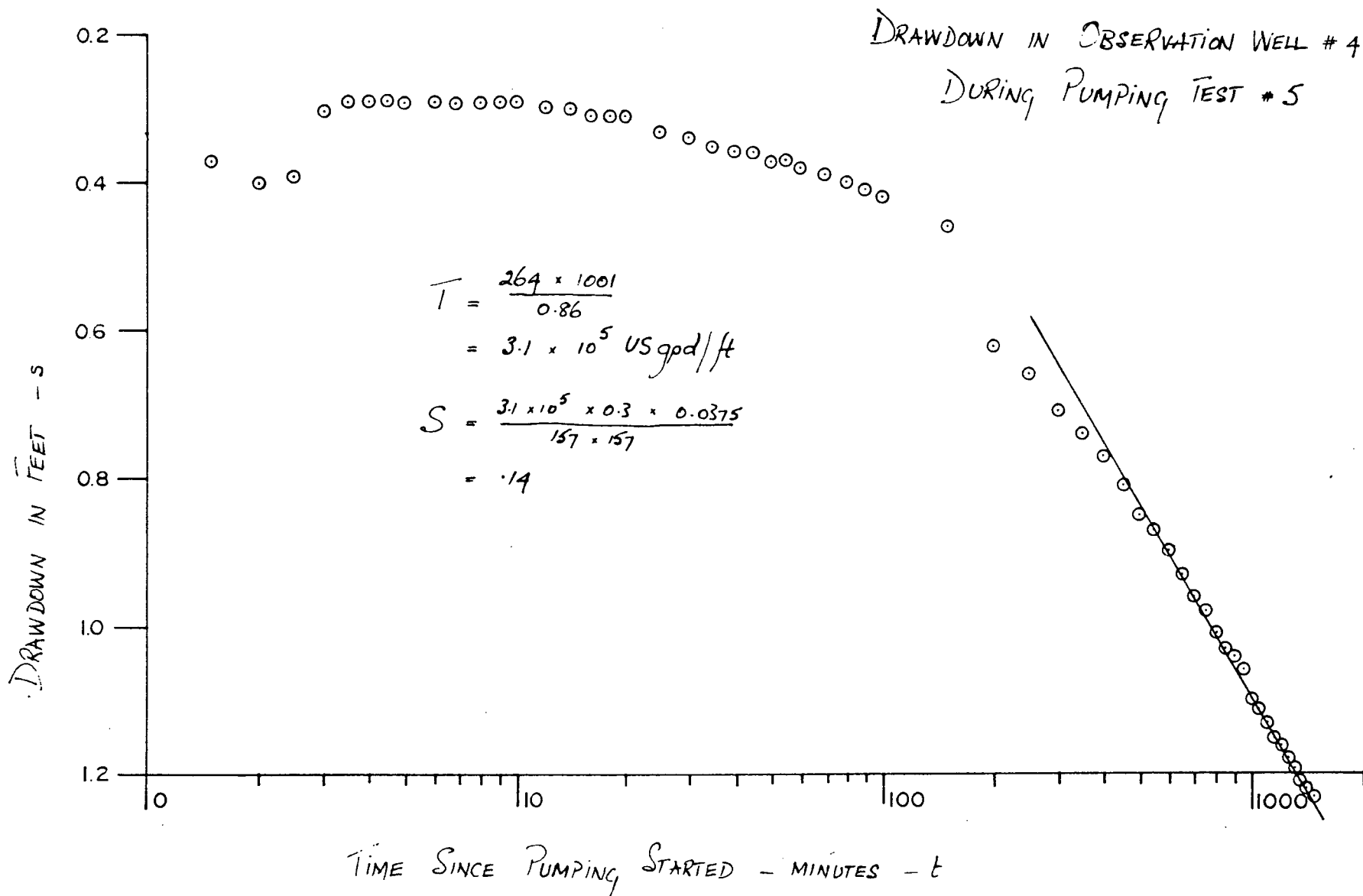
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FILE No. 0249723-A

DWG. No.

DATE



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SCALE: VERT.

HOR.

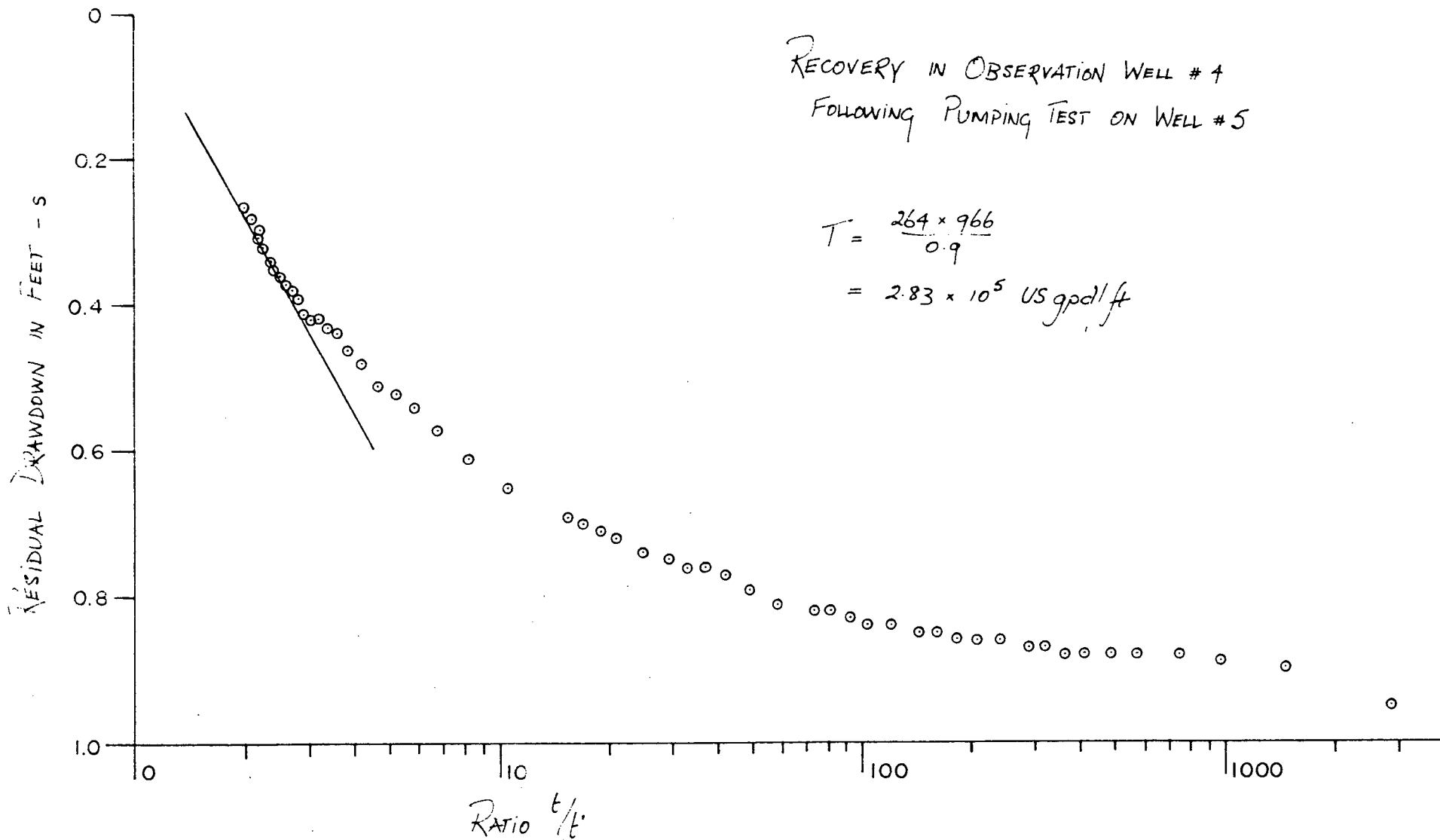
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FILE No. 0249723 - 4

DWG. No.



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WATER INVESTIGATIONS BRANCH

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SCALE: VERT.

HOR.

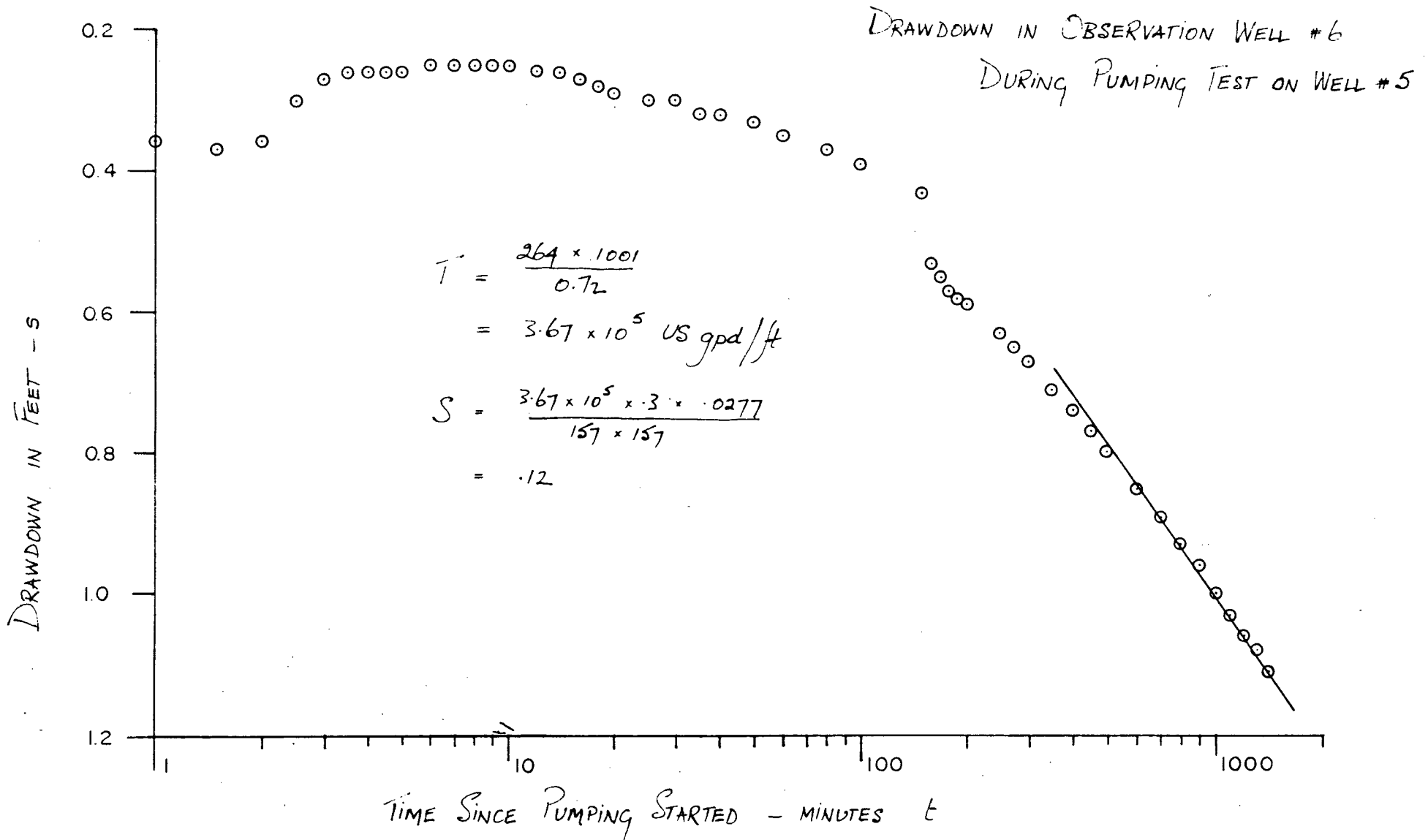
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WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

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FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.

HOR.

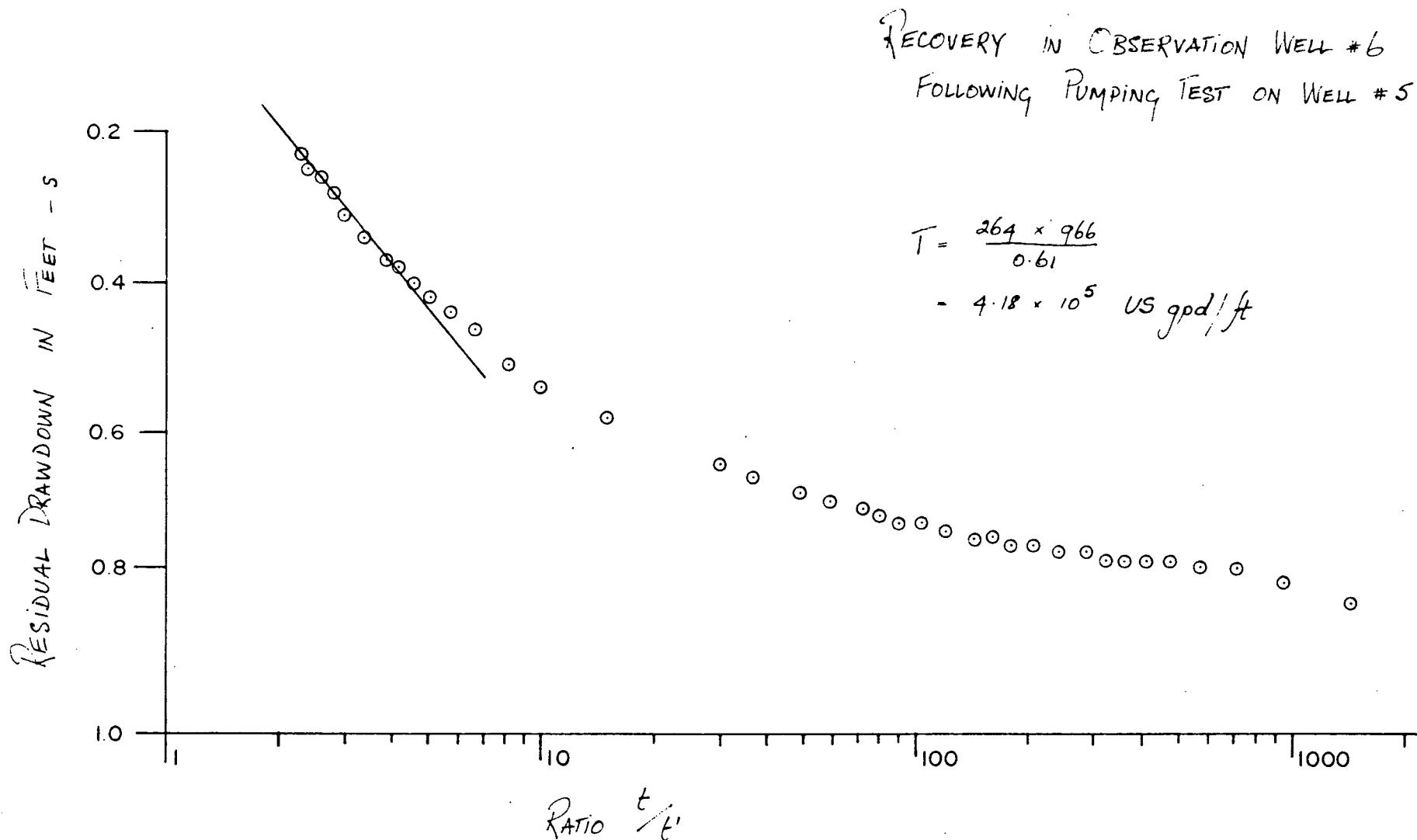
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DWG. No.

DATE



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DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.

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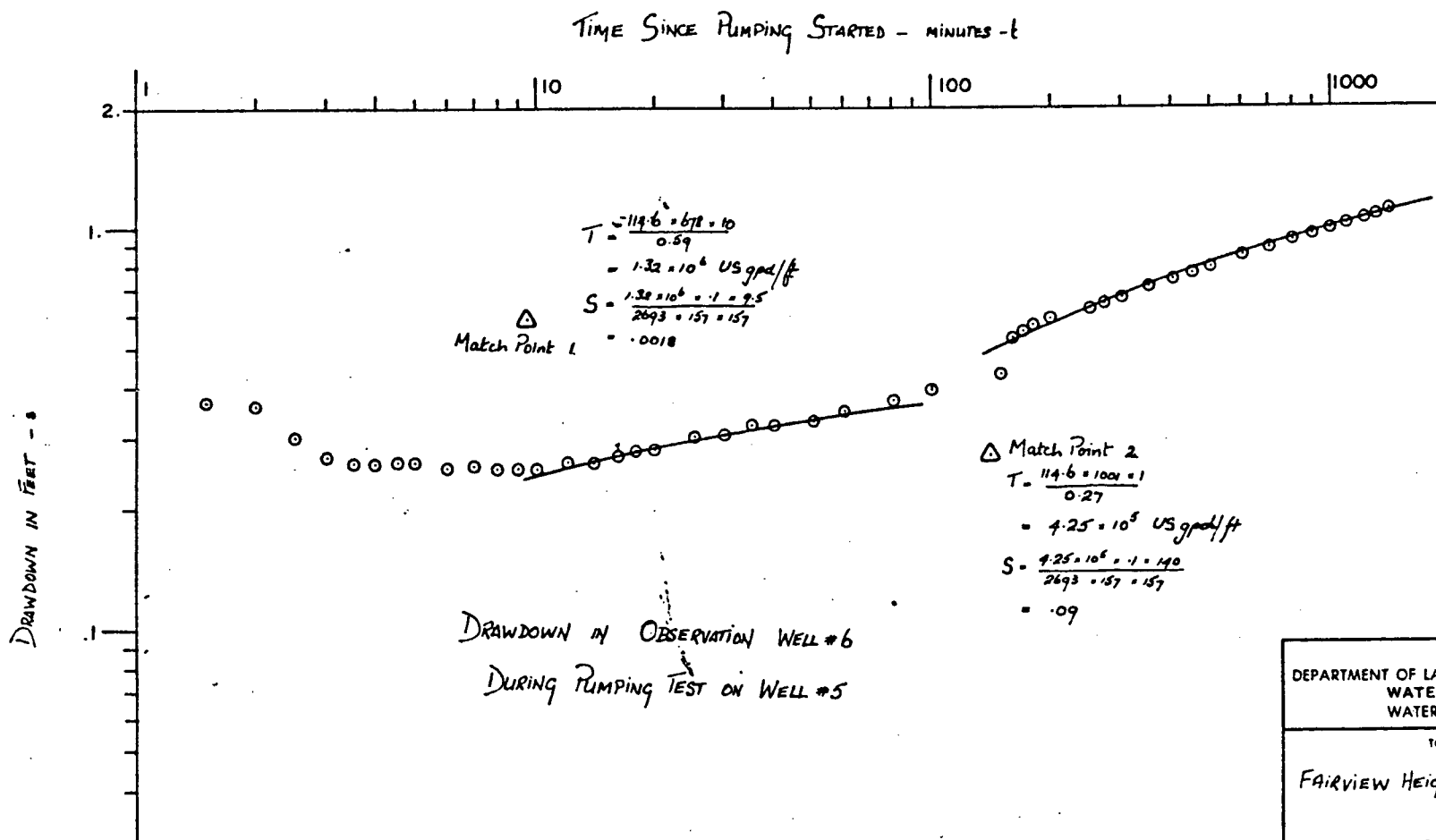
J. M. PETRIE

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FILE No. 0249723 - A

DWG. No.



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.

DATE

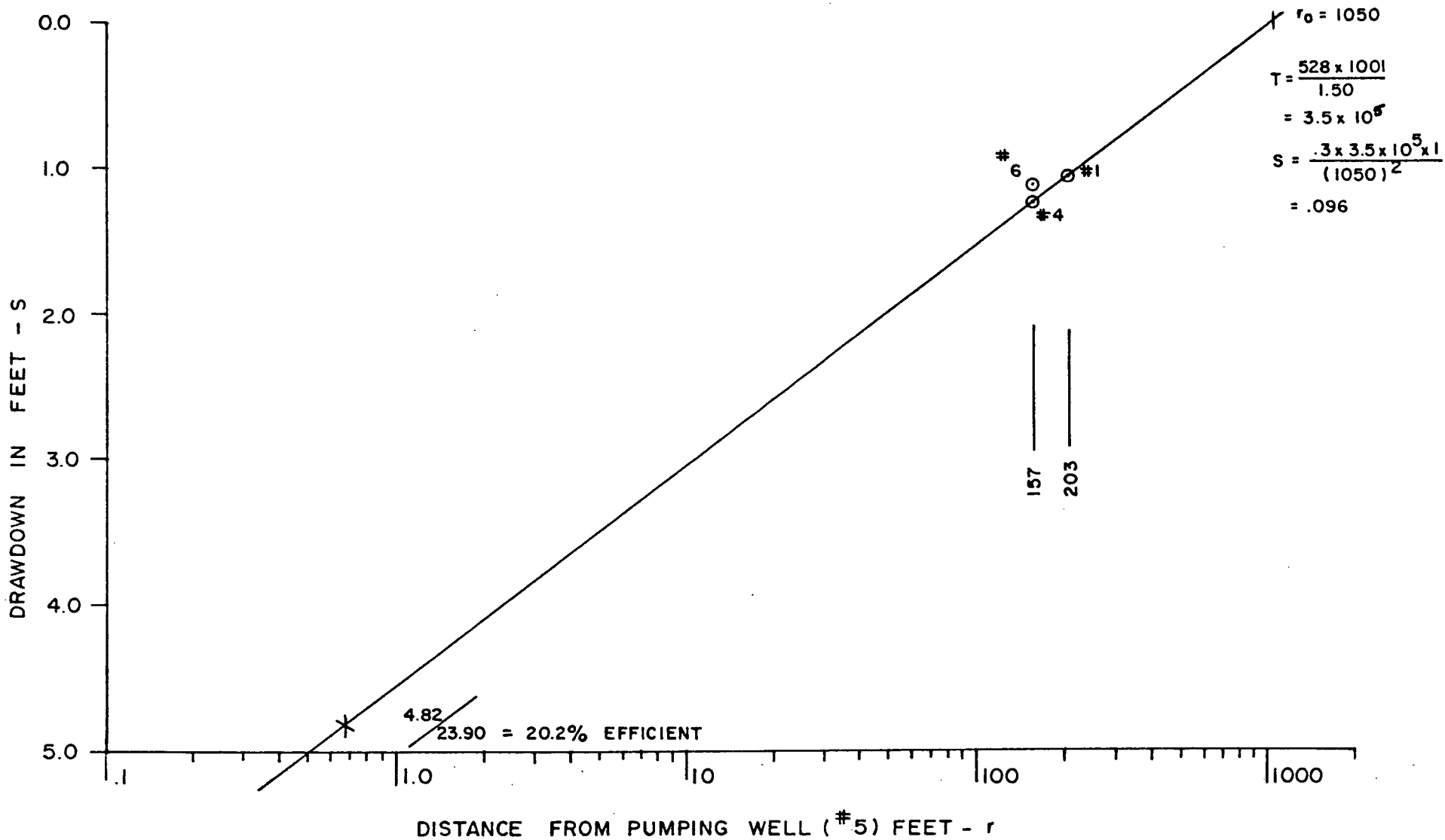
HOR.

J. M. PETRIE

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FILE No. 0249723 - A

DWG. No.



BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
FAIRVIEW HEIGHTS IRRIGATION DISTRICT
DISTANCE DRAWDOWN GRAPH
FOR PUMPING WELL # 5

SCALE: VERT. _____

HOR. N.T.S.

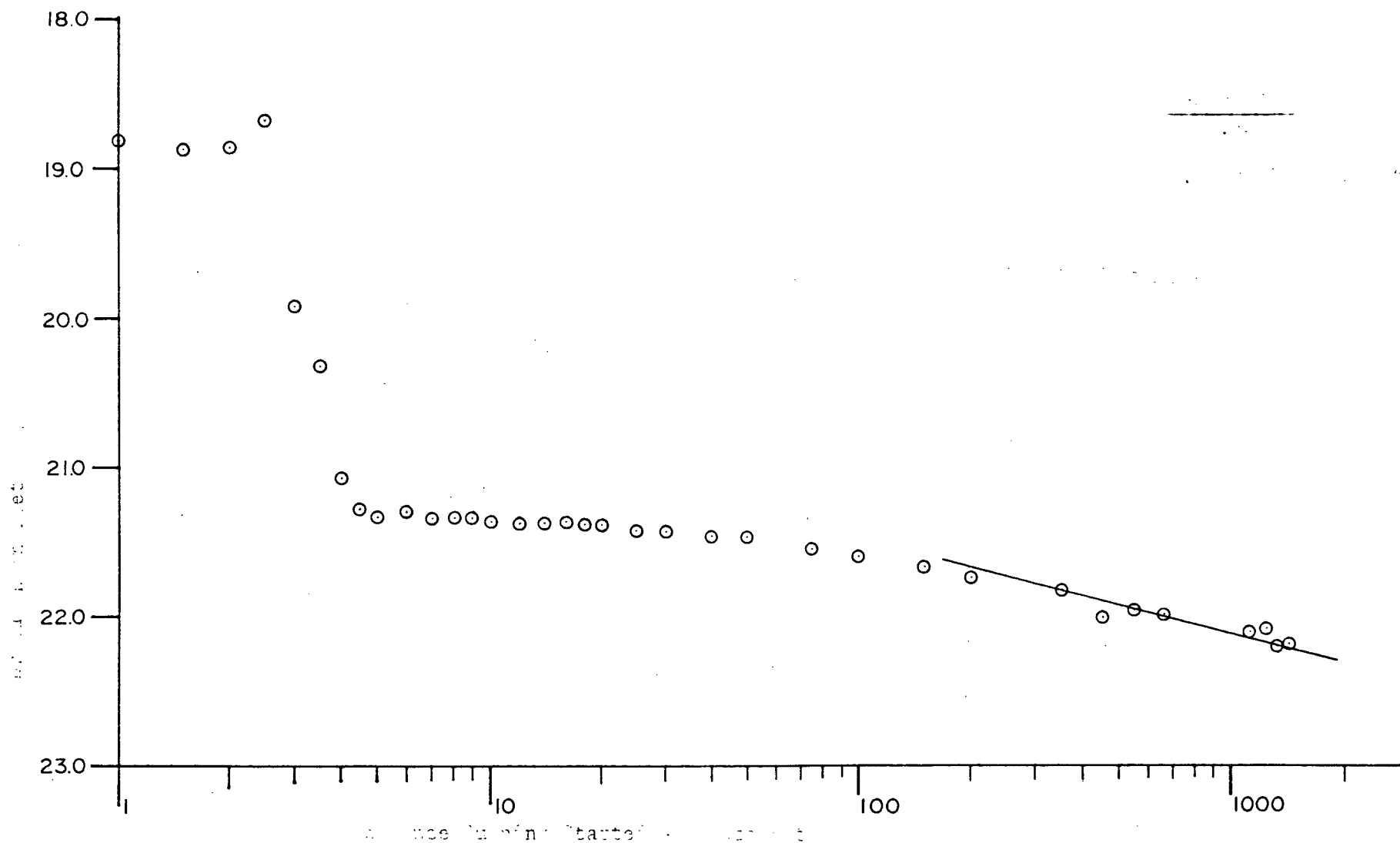
DATE

DEC. 1976

J. M. PETRIE ENGINEER

FILE No. 0249723

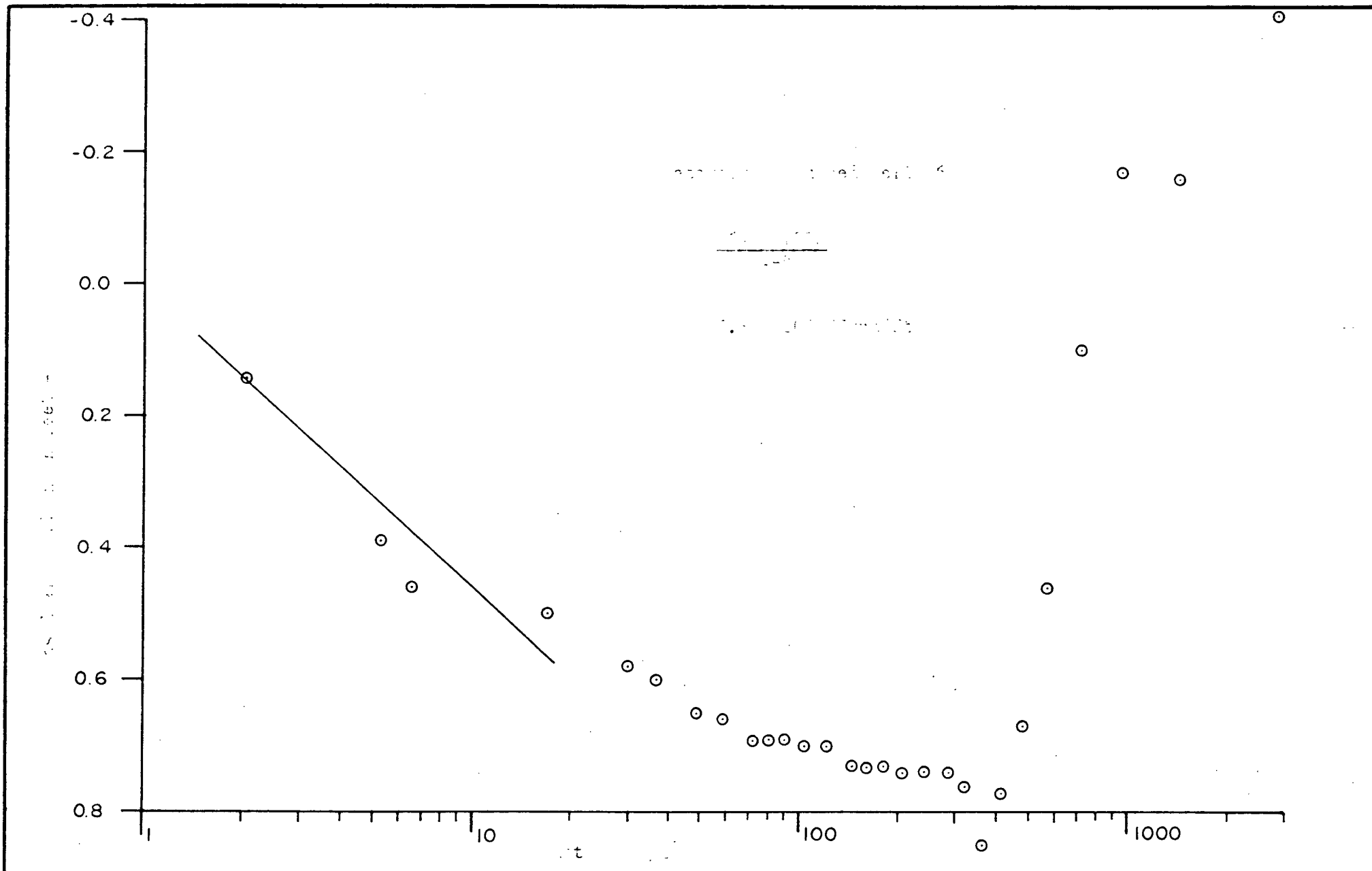
DWG. No. 0249723 - A



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DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
Laboratory tests on the effect of temperature on the rate of

SCALE: VERT.	DATE
HOR.	
.....ENGINEER	
FILE No. 1240723-	DWG. No.



BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

Investigation of the water resources of the Fraser River at

SCALE: VERT.

HOR.

DATE

J. M. Petrie

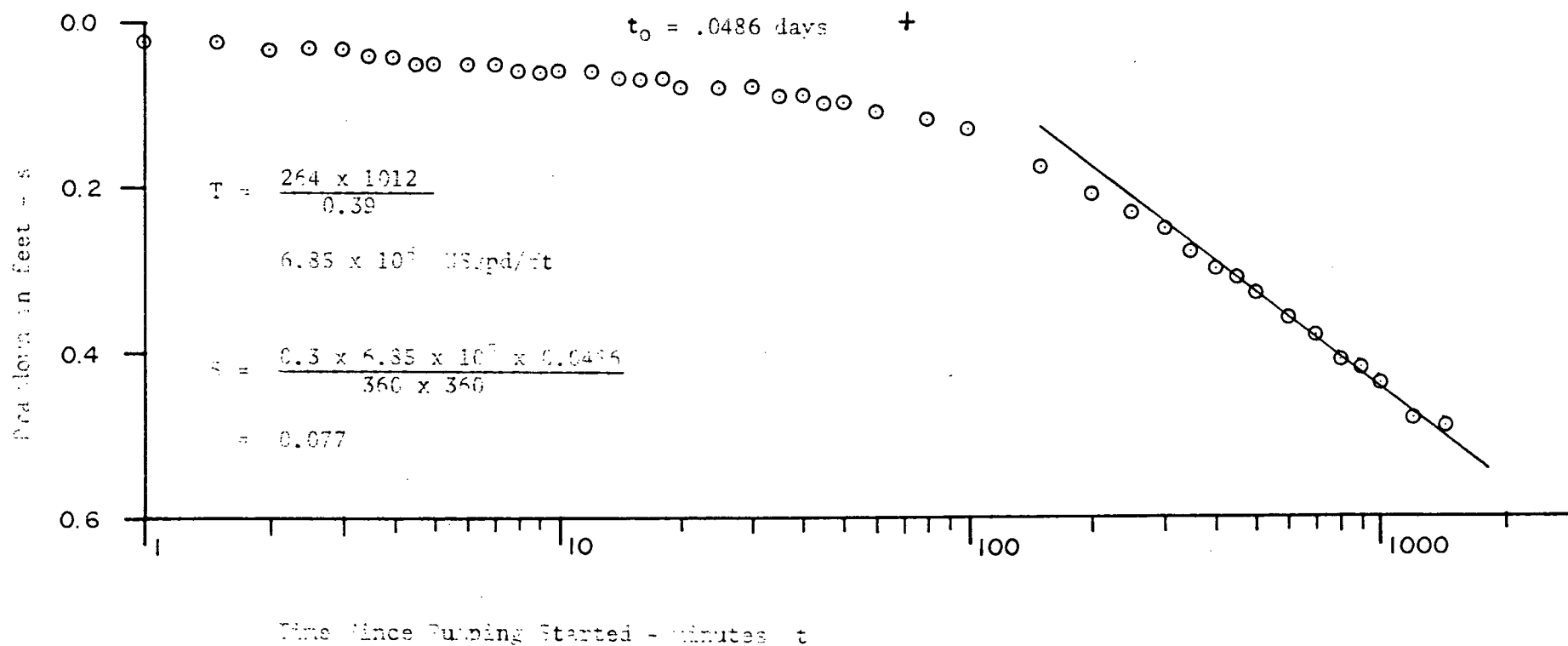
ENGINEER

FILE No. 1

DWG. No.

Drawdown in observation well
#1

During Pumping Test #6



BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

Garview Feasibility Investigation District

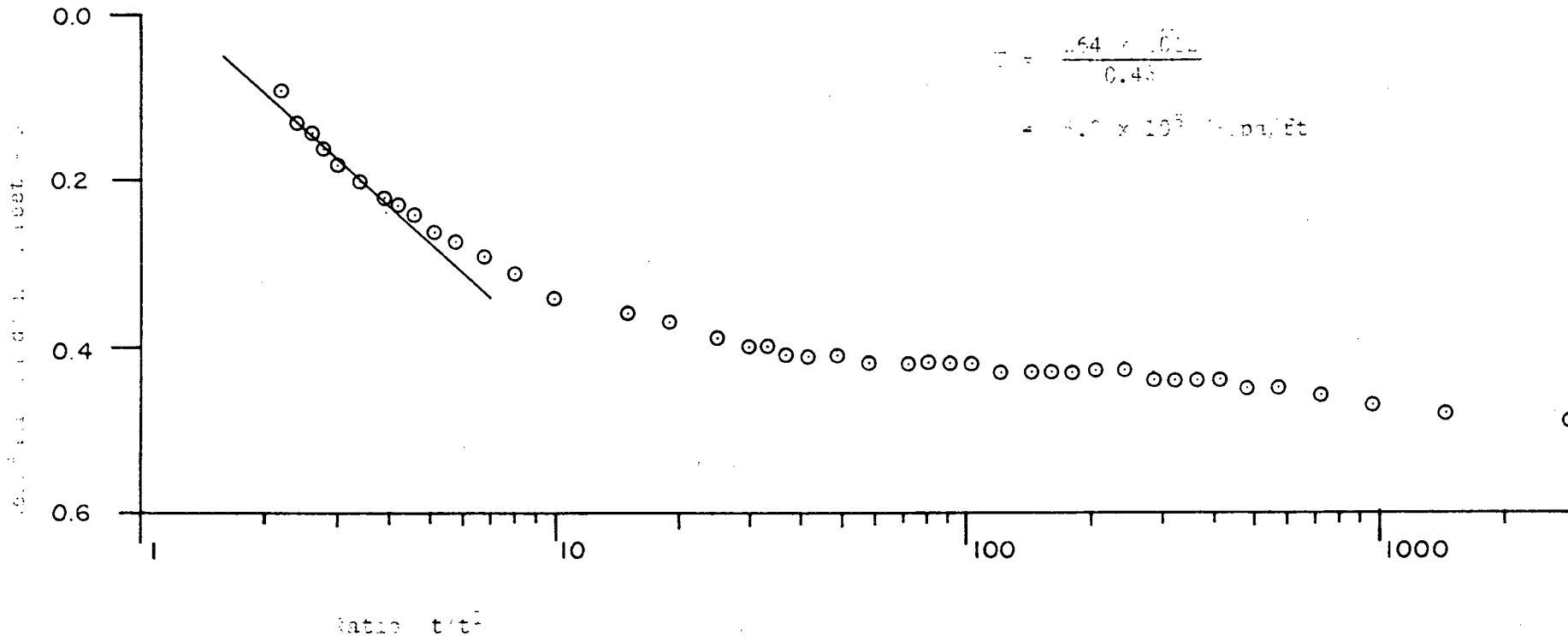
SCALE: VERT.

HOR.

DATE

J.M. Petrie ENGINEER

FILE No. 2246023-1 DWG. No.



BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

Fairview Heights Observation District

SCALE: VERT.

HOR.

J. M. Tetrie

DATE

ENGINEER

FILE No. 02-0723-1

DWG. No.

drawdown in Observation well #4

During Pumping Test #6

$$= \frac{264 \times 0.012}{0.1^2}$$

$$= 5.57 \times 10^3 \text{ gal/ft}$$

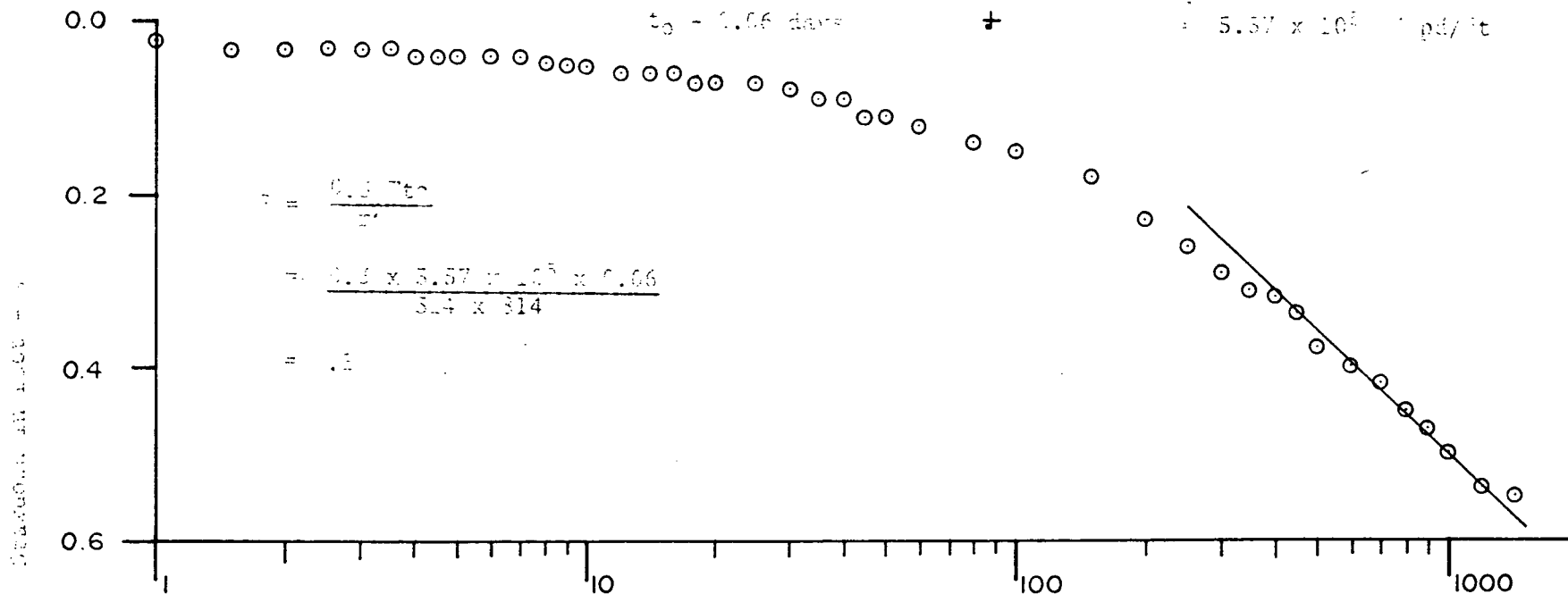
$t_0 = 1.56 \text{ days}$

+

$$s = \frac{0.17 t_0}{r^2}$$

$$= \frac{0.17 \times 5.57 \times 10^3 \times 0.06}{32.4 \times 314}$$

$$= .1$$



Time since Pumping Started - minutes t

BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

Fairview Heights Irrigation District

SCALE: VERT.

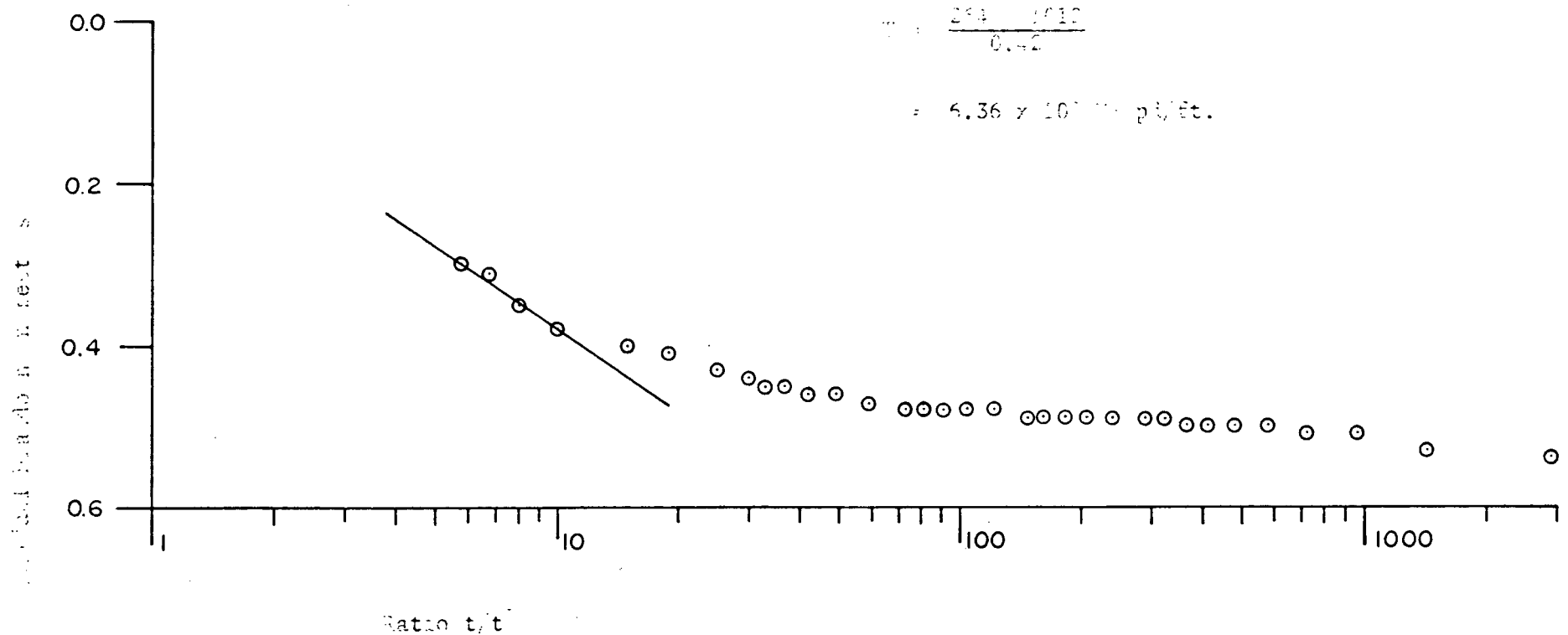
HOR.

DATE

..... ENGINEER

FILE No. 0218727-A DWG. No.

summary of observations on well #4
 following Pumpin Test #6



BRITISH COLUMBIA
 DEPARTMENT OF ENVIRONMENT
 WATER RESOURCES SERVICE
 WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

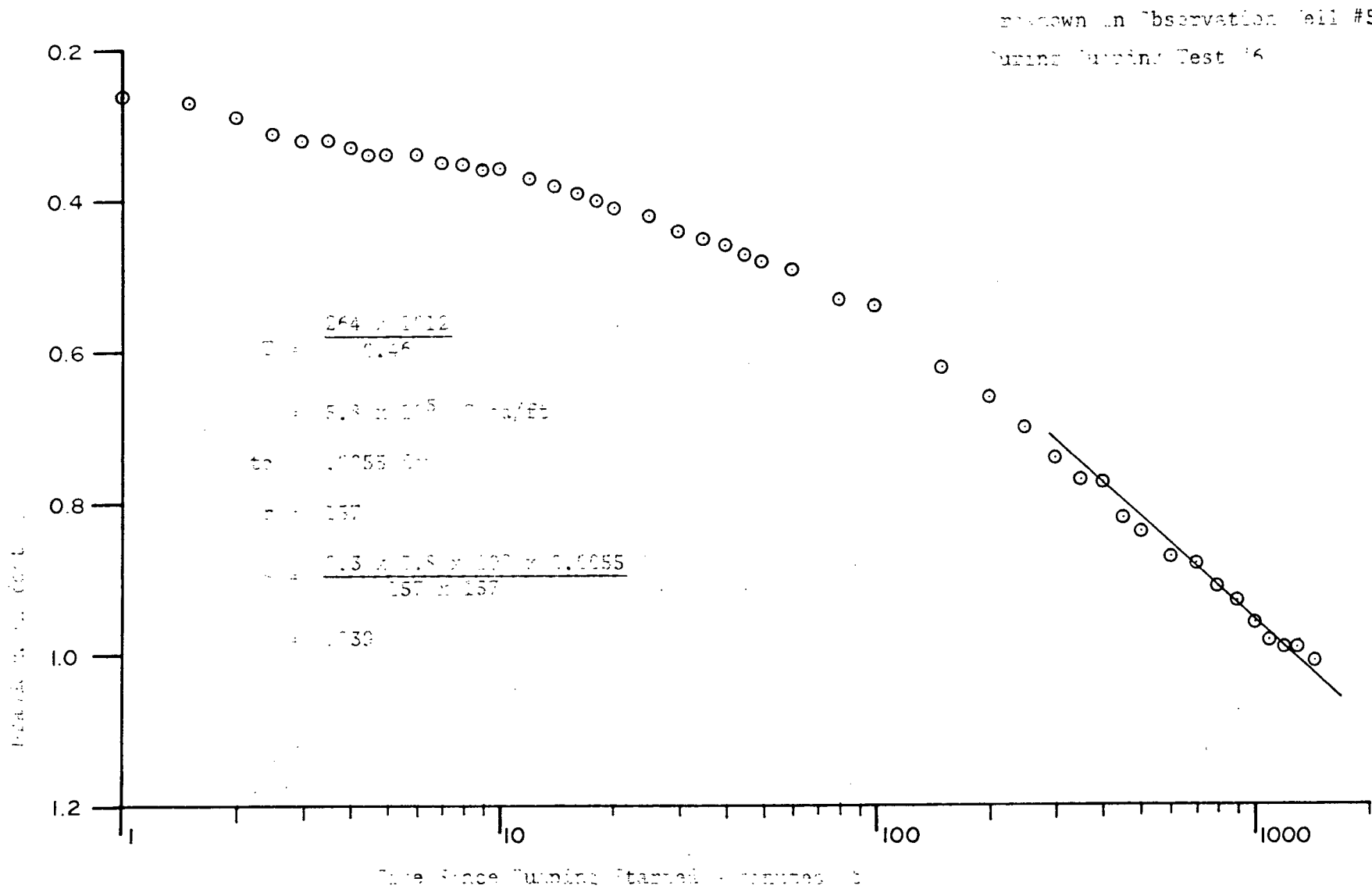
Palmer Heights Irrigation District

SCALE: VERT.

HOR.

DATE

FILE No. 2010/2011 DWG. No. ENGINEER



BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

Water Resources Service Report # 10

SCALE: VERT.

HOR.

DATE

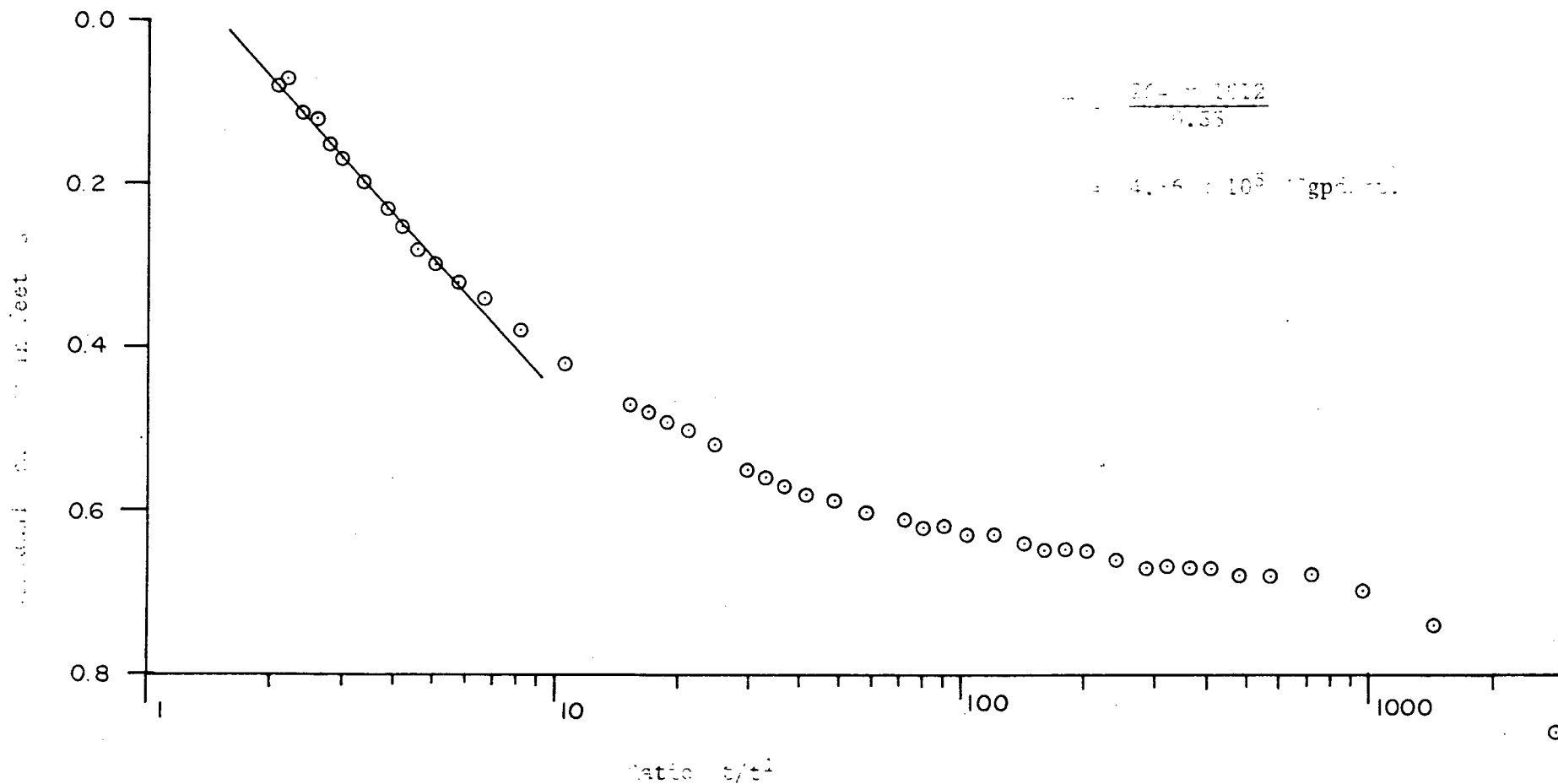
ENGINEER

FILE No.

1240723-1

DWG. No.

Power of Fairview Heights
following pumping test of



BRITISH COLUMBIA
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WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

Fairview Heights Irrigation District

SCALE: VERT.

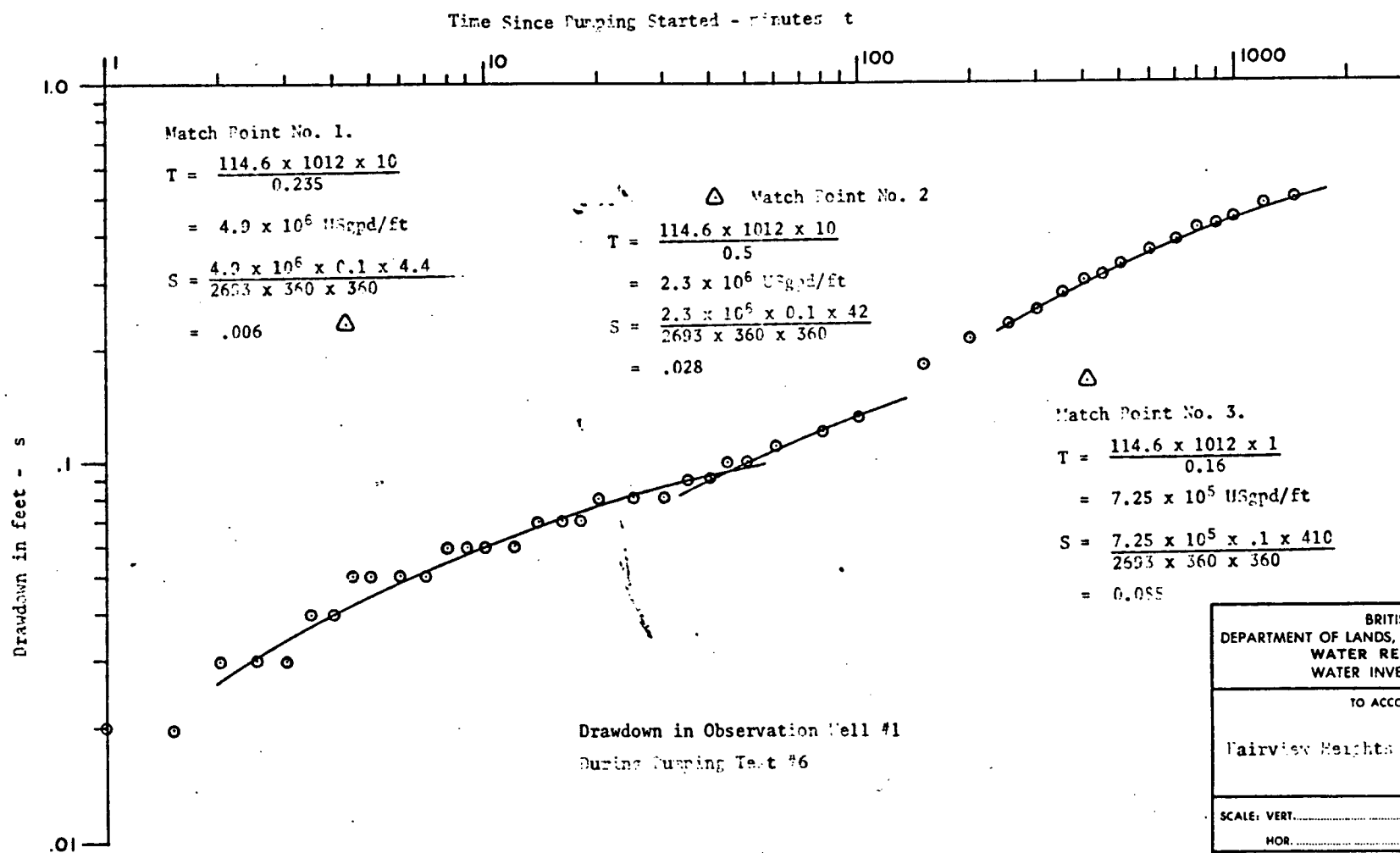
HOR.

DATE

ENGINEER

FILE No.

DWG. No.



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

Fairview Heights Irrigation District

SCALE: VERT.

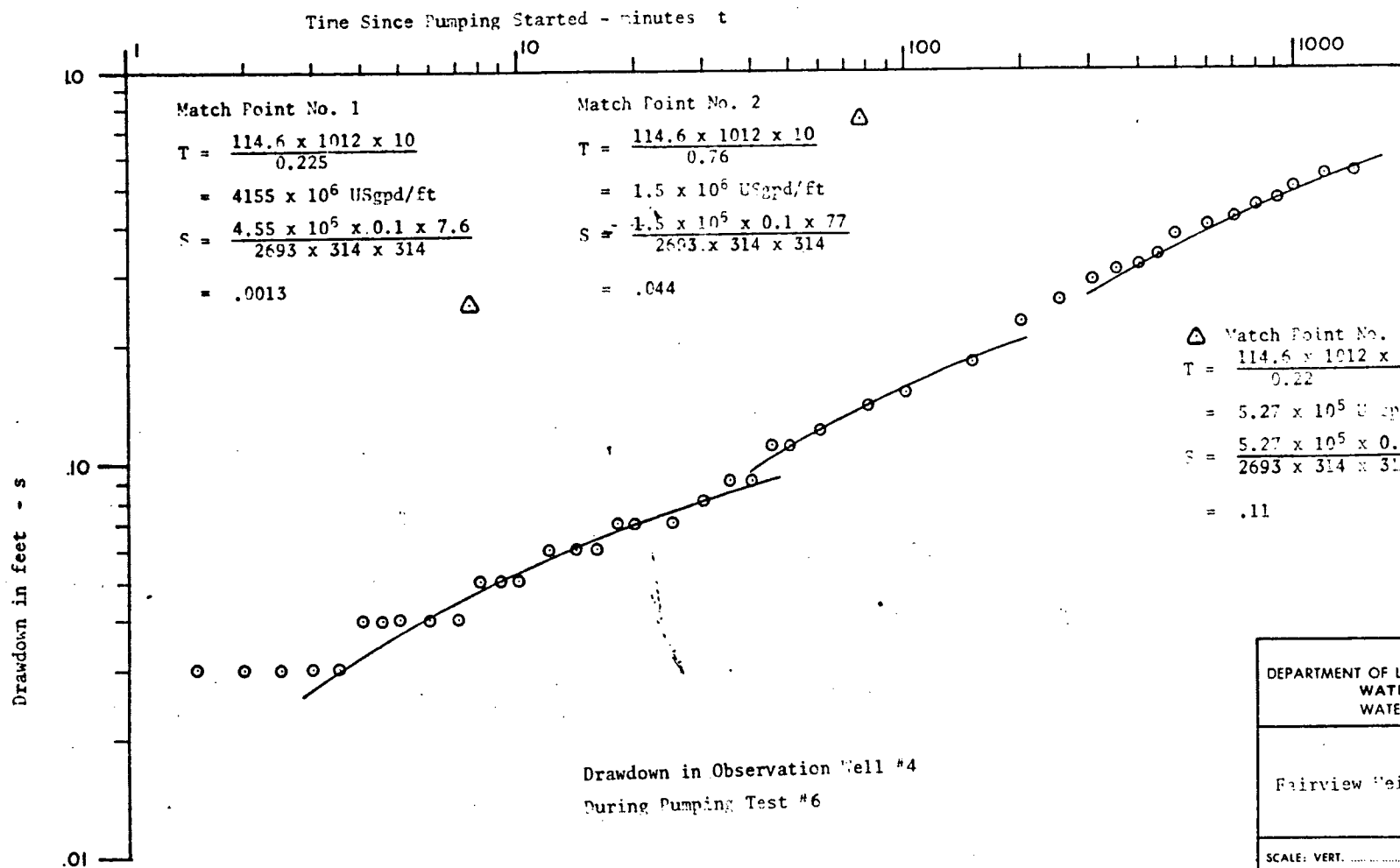
HOR.

DATE

FILE No. 0210725-A

DWG. No.

ENGINEER



Drawdown in Observation Well #4
During Pumping Test #6

BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

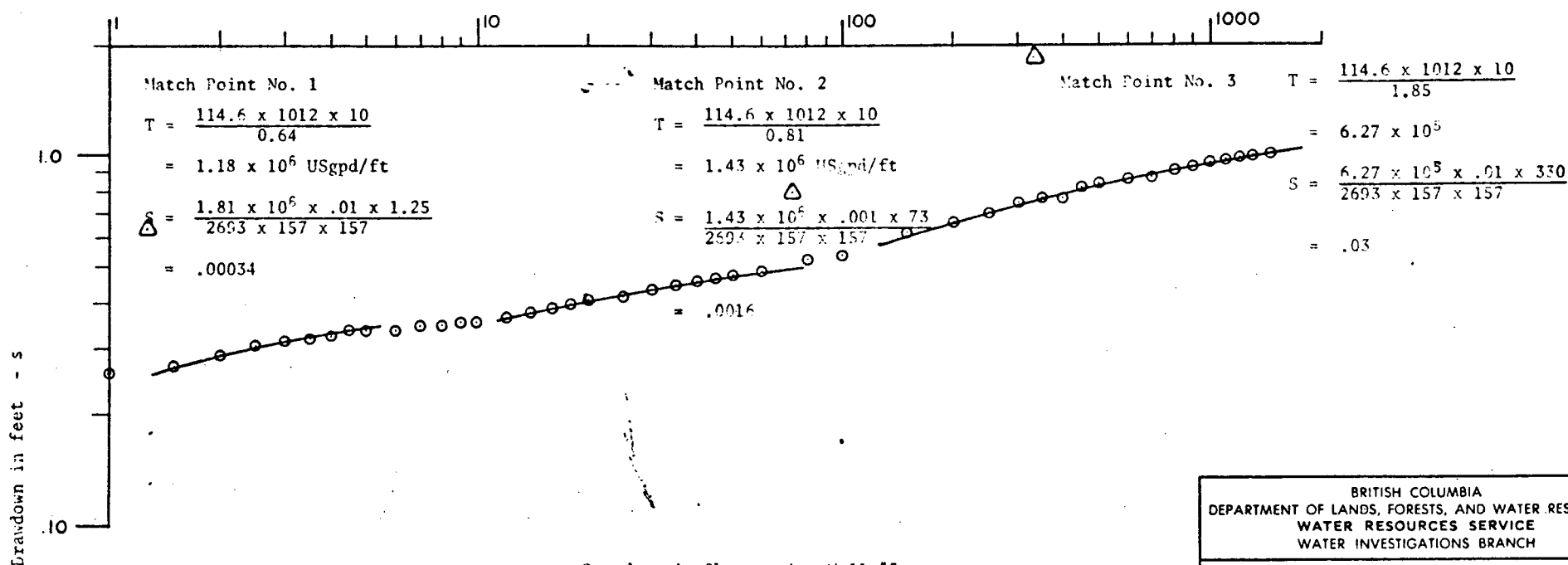
Fairview Heights Irrigation District

SCALE: VERT.
HOR.

DATE

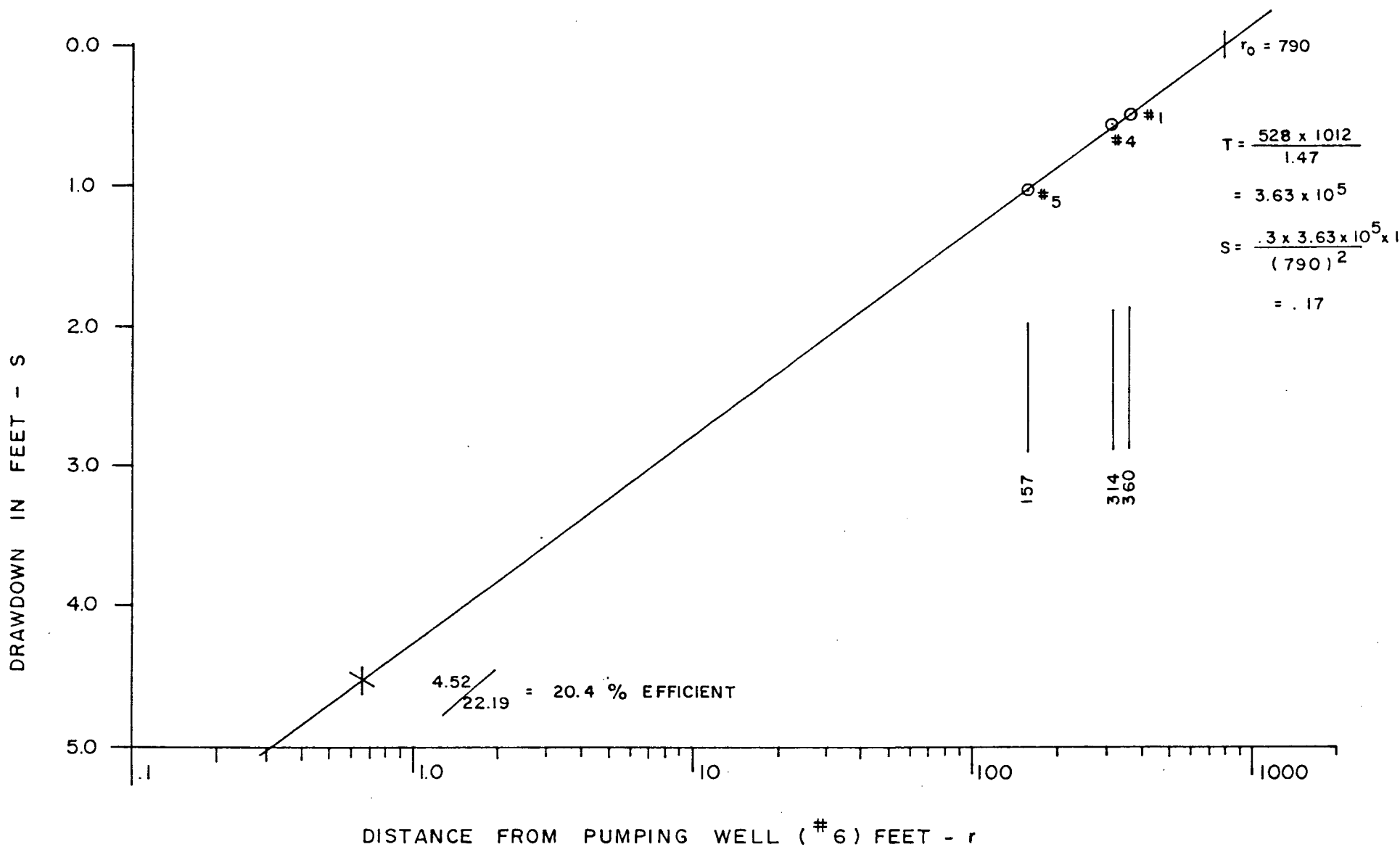
FILE No. 0248-124-1 DWG. No. ENGINEER

Time Since Pumping Started - minutes t



Drawdown in Observation Well #5
During Pumping Test #6

BRITISH COLUMBIA DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH	
TO ACCOMPANY REPORT ON	
Fairview Heights Irrigation District	
SCALE: VERT.	DATE
HOR.	
J. V. Petrie	ENGINEER
FILE No. 0240723-A	DWG. No.



BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
FAIRVIEW HEIGHTS IRRIGATION DISTRICT
DISTANCE DRAWDOWN GRAPH
FOR PUMPING WELL # 6

SCALE: VERT.	DATE
HOR. N.T.S.	DEC. 1976
J M PETRIE ENGINEER	
FILE No. 0249723	DWG. No. 0249723-A

APPENDIX D

OBSERVATION WELL HYDROGRAPHS

FROM PUMPING TESTS #5 and #6 - SITE #1

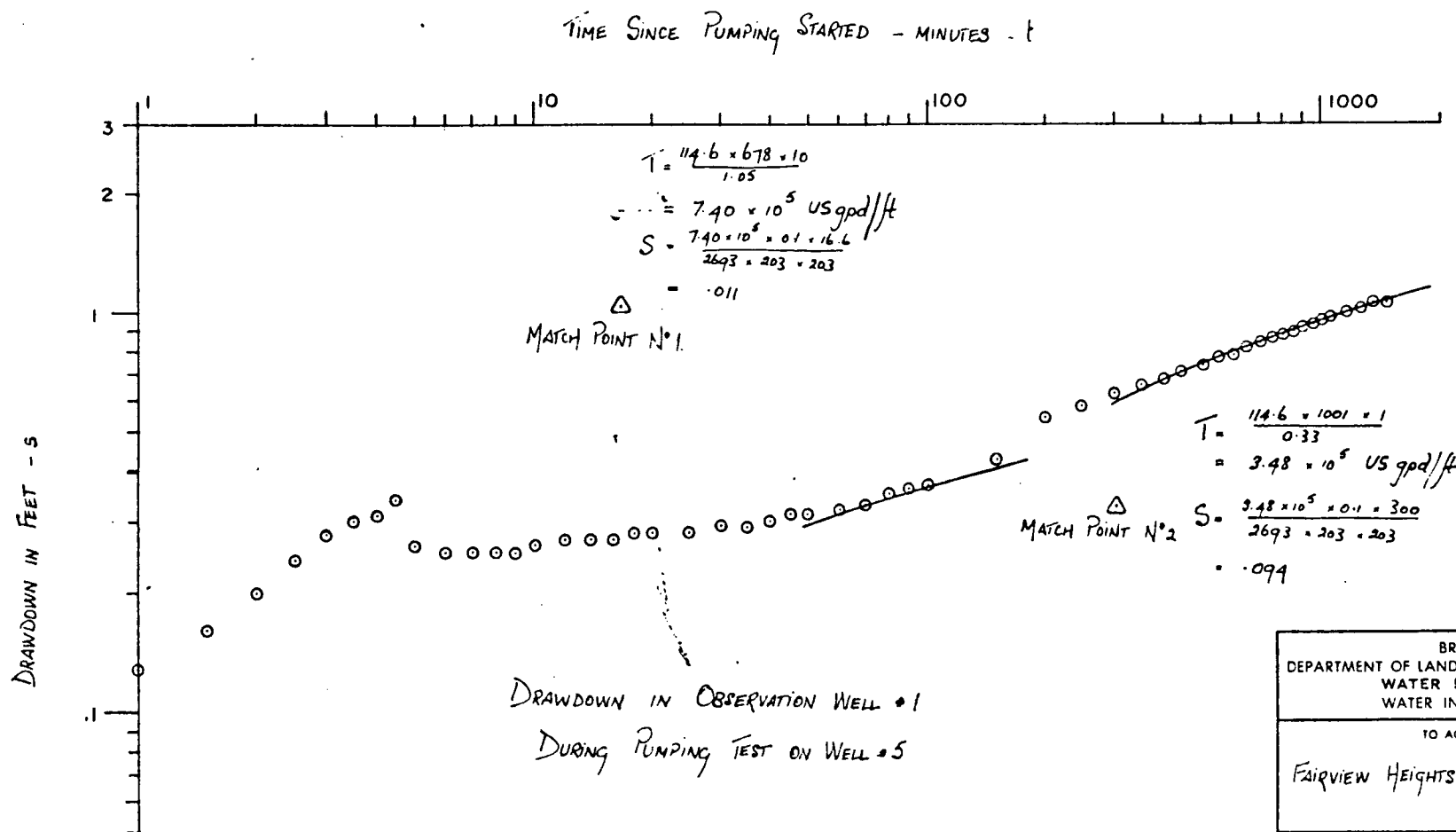
APPENDIX D

WELL #1 Hydrograph from pumping
 tests #5 and #6

WELL #4 Hydrograph from pumping
 tests #5 and #6

WELL #5 Hydrograph from pumping
 test #6

WELL #6 Hydrograph from pumping
 test #5



BRITISH COLUMBIA
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WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

Fairview Heights Irrigation District

SCALE: VERT.

DATE

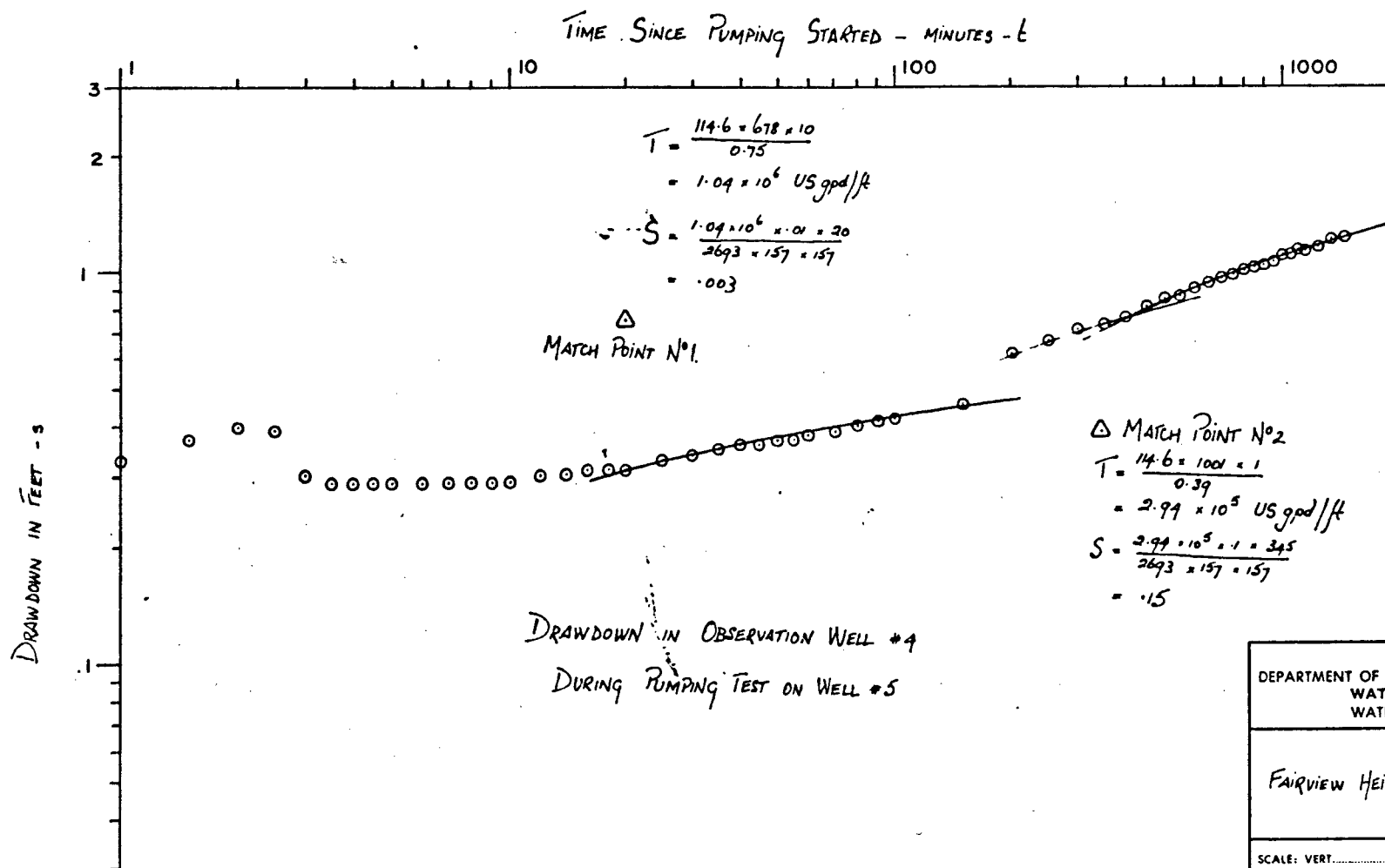
HOR.

J. M. PETRIE

ENGINEER

FILE No. 0249723 - A

CWG No.



BRITISH COLUMBIA
DEPARTMENT OF LANDS, FORESTS, AND WATER RESOURCES
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

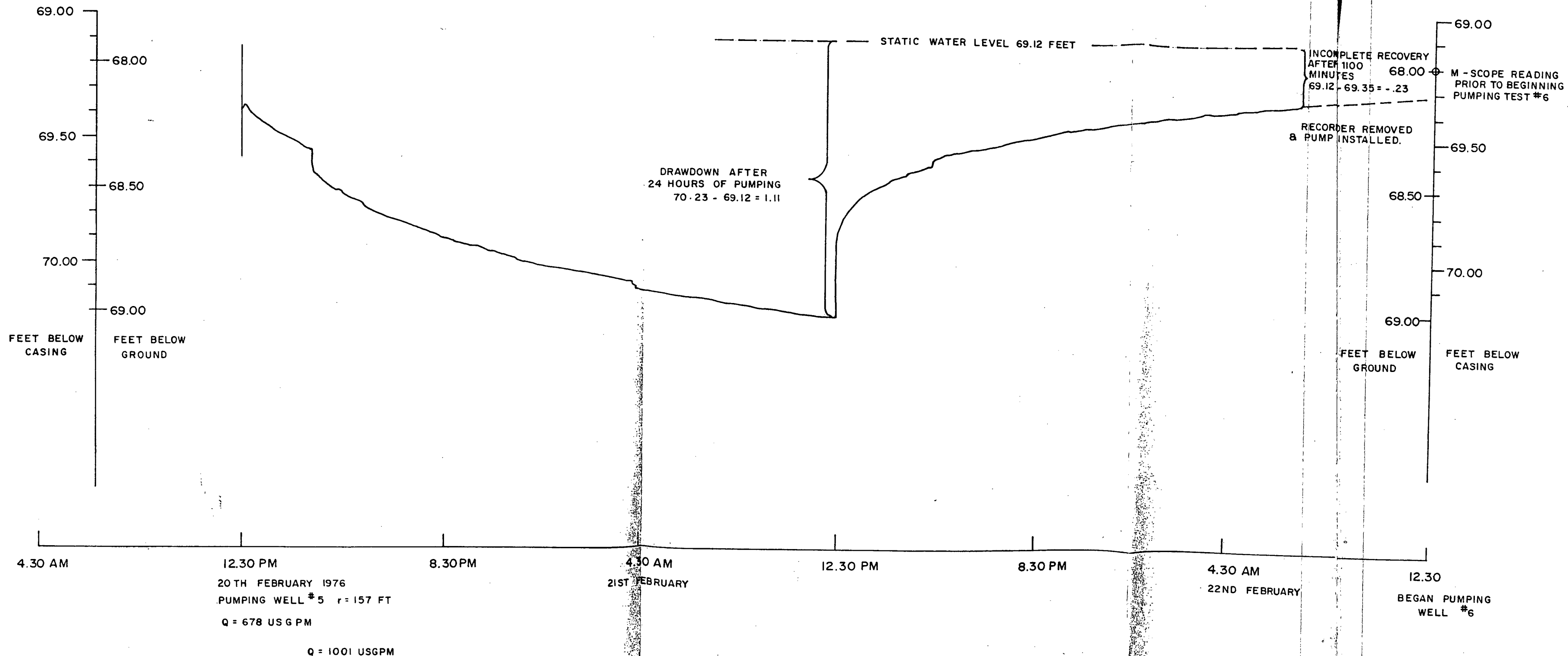
TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT. _____ DATE _____

HOR. _____
J. M. PETRIE ENGINEER

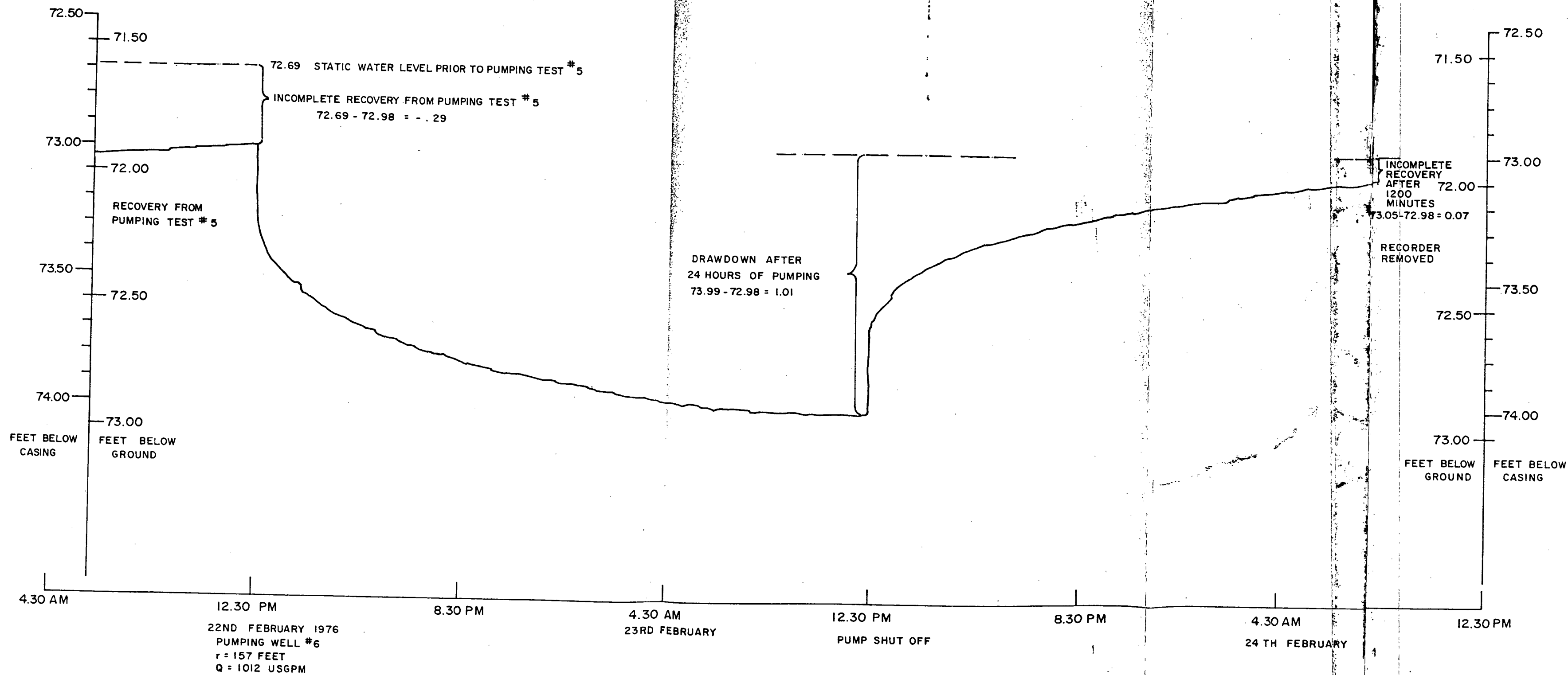
FILE No. 0249723-A DWG. No. _____



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DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
FAIRVIEW HEIGHT IRRIGATION DISTRICT
HYDROGRAPH FROM WELL #6
DURING PUMPING TEST #5

SCALE: VERT HORIZ	DATE NOV. 1976
N.T.S.	J.M. PETRIE ENGINEER
FILE No. 0249723	DWG. No. 0249723 - A



BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
FAIRVIEW HEIGHTS IRRIGATION DISTRICT
HYDROGRAPH FROM WELL #5
DURING PUMPING TEST #6

SCALE: VERT. _____	DATE
HOR. N.T.S.	NOV. 1976
J.M. PETRIE	ENGINEER
FILE No. 0249723	DWG. No. 0249723-A

APPENDIX E

WELL AND SCREEN DATA

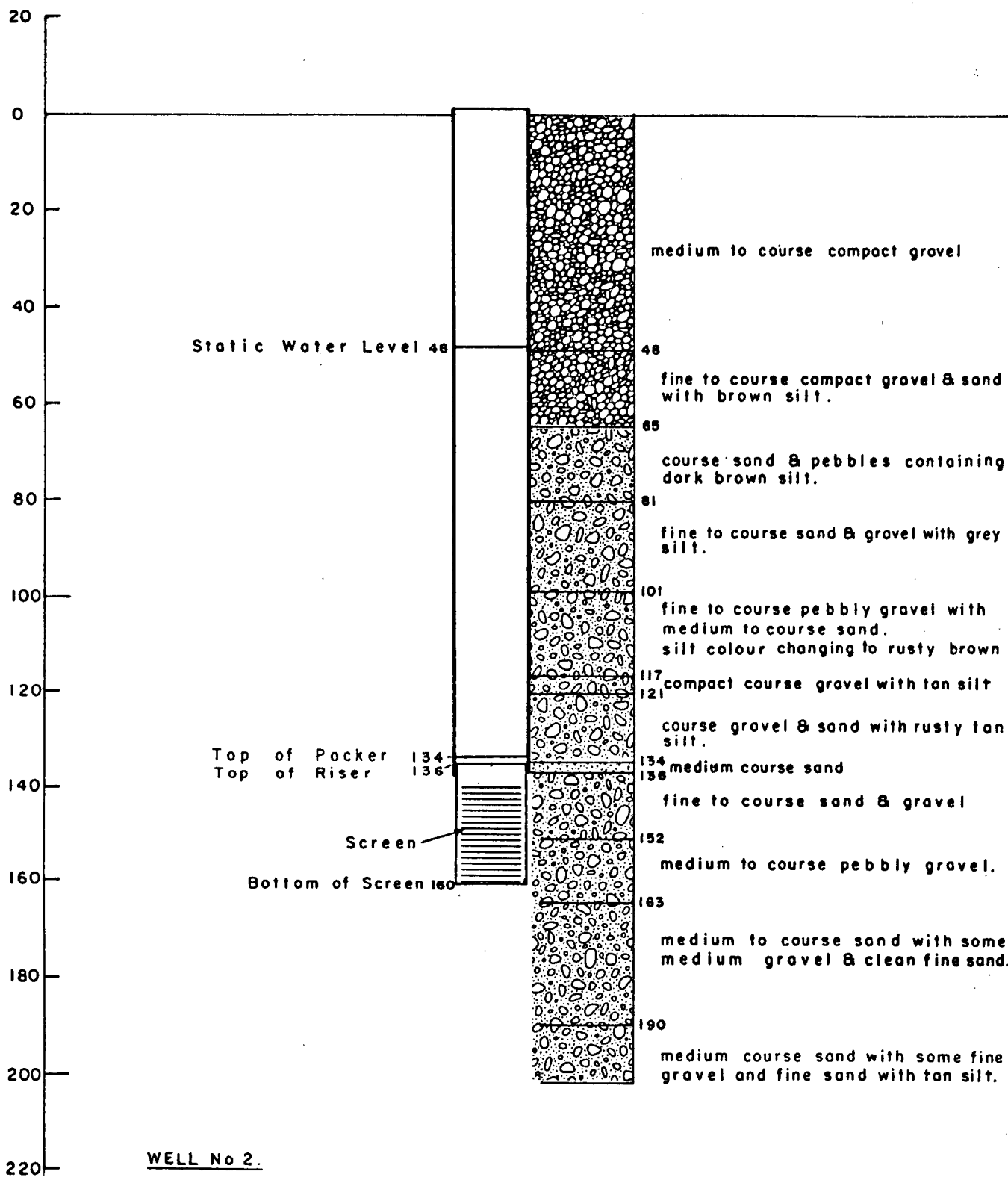
SITE #2

APPENDIX E

WELL #2 Well design and geology
 screen design table

WELL #3 Well design and geology
 Screen design table

Complete sieve analysis of all samples are located on the NTS
files (82E/4) in the Groundwater Section.



BRITISH COLUMBIA
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WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT. 1" = 30"
HOR. 1" = 16"

DATE

J. M. PETRIE

ENGINEER

FILE No. 0249723 - A

DWG. No.

DESIGN TABLE FOR SCREEN SLOT SIZE AND LENGTH

TEST HOLE #2

Depth	Thick- ness in feet	Effective grain size in thous. of an inch	Effective size squared	Possible range of screen slot openings in thous. of an inch			% of sample not sieved ½ in. or over	Depth in feet	Restricted range of screen slot opening in thous. of an inch	Multiple Slot Scr. Design			Final Screen Design	Optional Design
				Percentage retained 50%	40%	30%				Prelim.	Modif. based on Rule 1	Modif. based on Rule 2		
90-92	2			30	45	85	12.4							
92-94	2			60	+180	+180	33.6							
94-96	2			22	30	70	18.3							
97-98	1			110	+180	+180	31.3							
98-99	1			30	55	+180	27.0							
99-101	2			25	30	35	6.9							
101-103	2			30	37	42	10.7							
103-105	2			80	180	+180	19.7							
105-107	2			100	+180	+180	29.3							
108-111	3			38	105	+180	24.9							
111-113	2			25	30	43	10.5							
113-115	2			30	38	68	10.5							
115-117	2			32	43	82	14.1							
117-119	2			+180	+180	+180	46.7							
119-121	2			+180	+180	+180	51.9							
121-125	4			105	+180	+180	32.3							
125-127	2			115	180	+180	25.7							
127-129	2			+180	+180	+180	30.8							

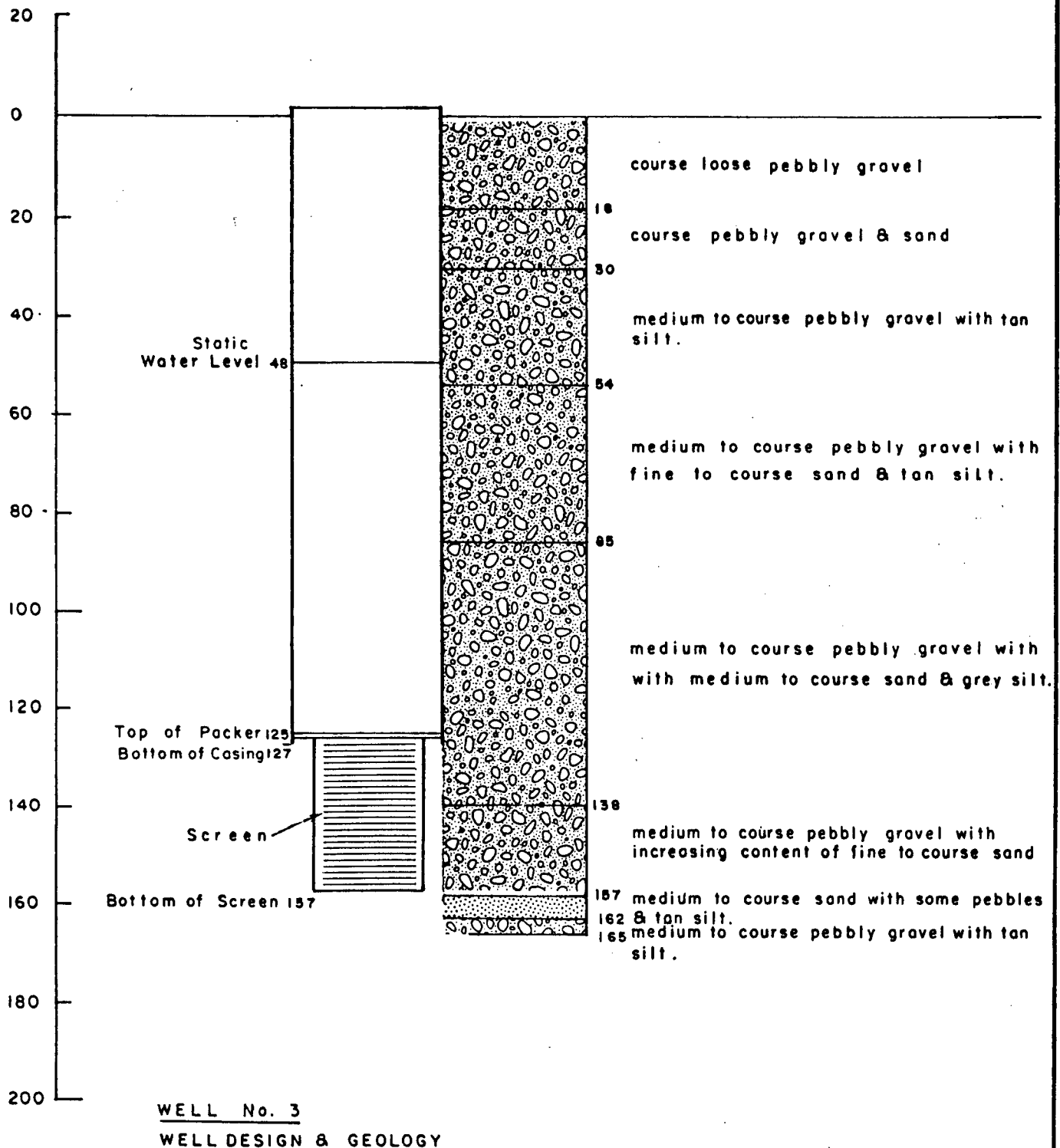
DESIGN TABLE FOR SCREEN SLOT SIZE AND LENGTH

TEST HOLE #2

Depth	Thick- ness in feet	Effective grain size in thous. of an inch	Effective size squared	Possible range of screen slot openings in thous. of an inch			% of sample not sieved ½ in. or over	Depth in feet	Restricted range of screen slot opening in thous. of an inch	Multiple Slot Scr. Design			Final Screen Design	Optional Design
				Percentage retained 50%	40%	30%				Prelim.	Modif. based on Rule 1	Modif. based on Rule 2		
129-131	2			+180	+180	+180	35.5			150	150	150		
132-134	2			40	120	+180	32.4			150	150	150		
134-135	1			25	30	40	14.1			30	NA	150		
135-137	2			68	+180	+180	34.9			150	150	150		
137-139	2			140	+180	+180	41.8			150	150	150		
139-141	2			38	70	170	21.5			150	150	150	From 140' 150	
141-143	2			43	100	+180	18.6			150	150	150	150	
143-145	2			43	80	156	18.5			150	150	150	150	
145-147	2			28	36	55	16.5			40	NA	150	150	
147-149	2			43	150	+180	34.3			150	150	150	150	
149-151	2			25	28	33	7.4			30	NA	150	150	
151-152	1			85	+180	+180	28.8			150	150	150	150	
152-154	2			+180	+180	+180	73.1			150	150	150	150	
154-156	2			180	+180	+180	31.6			150	150	150	150	
156-158	2			+180	+180	+180	29.1			150	150	150	150	
158-160	2			180	+180	+180	28.6			150	150	150	150	
160-162	2			78	146	+180	23.0			150	150	150		
162-165	3			45	68	110	17.6			110	NA	NA		

TEST HOLE #2

[illegible]



BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT. 1" = 30'
HOR. 1" = 16'

DATE

J. M. PETRIE

ENGINEER

FILE No. 0249723 - A

DWG. No.

TEST HOLE #3

[illegible]

APPENDIX F

PUMPING TEST DATA

SITE #2

APPENDIX F

WELL #2 Drawdown data
 Recovery data

WELL #3 Drawdown data
 Recovery data
 Drawdown data - observation well #2
 Recovery data - observation well #2
 Drawdown data - Willis well
 Recovery data - Willis well

APPENDIX

PUMPING TEST DATA FROM WELL NO. 2

Date 8 October 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	
0:00 am	0.0	46.60	0.0	16.5	503	5-inch orifice on 6-inch
	0.5	49.32	2.72			
	1.0	49.36	2.76			
	1.5	49.44	2.84			
	2.0	49.44	2.84			
	2.5	49.48	2.88			
	3.0	49.50	2.90			
	3.5	49.48	2.88			
	4.0	49.52	2.92			
	4.5	49.58	2.98			
	5.0	49.58	2.98			
	6	49.57	2.97			
	7	49.57	2.97			
	8	49.65	3.05			
	9	-	-			
	10	49.64	3.04			
	12	49.60	3.00			
	14	49.65	3.05			
	16	49.69	3.09			
	18	49.74	3.14			
	20	49.74	3.14			
	25	49.61	3.01			
	30	49.67	3.07			
	35	49.67	3.07			
	40	49.66	3.06			
	45	49.64	3.04			
	50	49.68	3.08			
	55	49.59	2.99			
11:00 am	60	49.63	3.03	40	781	specific capacity 503/3.03 = 166 Usgpm/ft increased engine speed
	61	52.31	5.71			
	62	52.21	5.61			
	63	52.05	5.45			
	64	52.16	5.56			
	65	52.18	5.58			

APPENDIX

PUMPING TEST DATA FROM WELL NO. 2

Date 8 October 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	
	66	52.16	5.56	40	781	
	67	52.21	5.61			
	68	52.17	5.57			
1:10 am	69	52.18	5.58			
	70	52.15	5.55			
	75	52.20	5.60			
	80	52.18	5.58			
	85	52.21	5.61			
	90	52.22	5.62			
	95	52.20	5.60			
	100	52.22	5.62			
	105	52.22	5.62			
2:15 pm	110	52.22	5.62			
	135	52.30	5.70			specific capacity
1:00 pm	160	52.39	5.79			$781/5.66 = 138$ USgpm/ft
	180	52.26	5.66			
	200	51.31	4.71	30	668	decreased engine speed
	250	51.37	4.77			at 190 minutes as pump
	300	51.36	4.76			overheating.
	350	51.39	4.79			
	400	51.39	4.79			
	450	51.37	4.77			
	500	51.37	4.77			
8:00 pm	550	51.36	4.76			
	600	51.39	4.79			
	650	51.40	4.80			
10:30 pm	700	51.40	4.80			
	750	51.39	4.79			

APPENDIX

PUMPING TEST DATA FROM WELL NO. 2

Date _____

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	
12:10 am	800	51.40	4.80	30	668	9 October 1975
	850	51.40	4.80			
	900	51.40	4.80			
	950	51.41	4.81			
	1000	51.41	4.81			
	1050	51.42	4.82			
	1100	51.42	4.82			
5:10 am	1150	51.43	4.83			
	1200	51.42	4.82			
	1250	51.43	4.83			
	1300	51.44	4.84			specific capacity 668/4.89 = 137 US gpm/ft
8:30 am	1350	51.43	4.83			
	1400	51.42	4.82			
9:00 am	1440	51.49	4.89	30	668	
						pump shut off

APPENDIX

RECOVERY READINGS IN WELL NO. 2 AFTER PUMPING TEST

Date 9 October 1975

Time	Time (t) since start of pumping in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet	Residual drawdown in well (static =)	Static 46.60' below casing
10:00 am	1440	0.0		51.49	4.89	
		0.5	2881	47.15	0.55	
		1.0	1441	47.07	0.47	
		1.5	961	46.91	0.37	
		2.0	721	46.91	0.31	
		2.5	577	46.84	0.24	
		3.0	481	46.84	0.24	
		3.5	412	46.81	0.21	
		4.0	361	46.82	0.22	
		4.5	321	46.80	0.20	
		5.0	289	46.78	0.18	
		6.0	241	46.79	0.19	
		7.0	207	46.81	0.21	
		8.0	181	46.81	0.21	
		9.0	161	46.80	0.20	
	1450	10.0	145	46.80	0.20	
		12	121	46.78	0.18	
		14	104	46.75	0.15	
		16	91	46.74	0.14	
		18	81	46.73	0.13	
		20	73	46.73	0.13	
		25	59	46.72	0.12	
		30	49	46.71	0.11	
		35	42	46.71	0.11	
		40	37	46.72	0.12	
		45	33	46.72	0.12	
	1490	50	30	46.71	0.11	
		75	21	46.70	0.10	
		100	15	46.70	0.10	
11:40 am	1540	150	10	46.69	0.09	
		200	8.2	46.63	0.03	
		250	6.7	46.64	0.04	
3:00 pm	1740	300	5.8	46.64	0.04	

APPENDIX

PUMPING TEST DATA FROM WELL NO. 3

Date 25 November 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	
1:00 pm	0.0	48.24		23	1500	8-inch orifice on 10-inch pipe
	0.5	53.05	4.81			
	1.0	53.07	4.83			
	1.5	53.73	5.49			
	2.0	53.70	5.46			
	2.5	53.71	5.47			
	3.0	53.68	5.44			
	3.5	53.68	5.44			
	4.0	53.61	5.37			
	4.5	53.51	5.27			
	5.0	53.48	5.24			
	6	53.45	5.21			
	7	53.43	5.14			
	8	53.38	5.14			
	9	53.39	5.15			
	10	53.41	5.17			
	12	53.39	5.15			
	14	53.41	5.17			
	16	53.41	5.17			
	18	53.43	5.19			
3:30 pm	20	53.52	5.28	39.5	1963	specific capacity 1500/5.42 = 277 USgpm/ft increased engine speed
	25	53.58	5.34			
	30	53.66	5.42			
	31	59.08	10.84			
	32	59.07	10.83			
	33	58.95	10.71			
	34	59.03	10.79			
	35	59.03	10.79			
	36	59.11	10.87			
	37	59.11	10.87			
	38	59.11	10.87			
	39	59.01	10.77			
	40	59.05	10.81			

PUMPING TEST DATA FROM WELL NO. 3

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Height of water in tube on orifice pipe in inches	U.S. gals. per min. discharge from well	
3:46 pm	42 44 46	58.77 58.05 58.33	10.53 9.81 10.09	39.5	1963	engine speed irregular engine shut off because of overheating problems. Well recovered prior to start up.
4:30 pm	0 50 100	56.41 56.71 56.77	8.17 8.47 8.53	35	1837	
7:00 pm	150 200 250 300 350 400	56.71 56.83 56.79 56.91 56.91 56.93	8.47 8.59 8.55 8.67 8.67 8.69			
2:00 mid.	450 500 550 600 650 700	56.84 56.92 56.87 56.94 56.86 56.96	8.60 8.68 8.63 8.70 8.62 8.72			26 November
5:00 am	750 800 850 900	56.98 56.92 56.96 56.98	8.74 8.68 8.72 8.74			
8:20 am	950	56.97	8.73	35	1837	specific capacity 1837/8.73 = 210 USgpm/ft pump shut off
	Initial 90 minutes of pumping ignored because of engine failure, thus total pumping time taken as 950 minutes.					

Initial 90 minutes of pumping ignored because of engine failure, thus total pumping time taken as 950 minutes.

APPENDIX

RECOVERY READINGS IN WELL NO. 3 AFTER PUMPING TEST

Date 26 November 1975

Time	Time (t) since start of pumping in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet	Residual drawdown in well (static =)	Static 48.24 feet below ground.
8:20 am	950	0.0		56.97	8.73	
		0.5	1901	48.82	0.58	
		1.0	951	48.92	0.68	
		1.5	634	48.89	0.65	
		2.0	476	48.92	0.68	
		2.5	381	48.92	0.68	
		3.0	317	48.91	0.67	
		3.5	272	48.87	0.63	
		4.0	239	48.87	0.63	
		4.5	212	48.86	0.62	
		5.0	191	48.82	0.58	
		6	159	48.80	0.56	
		7	137	48.80	0.56	
		8	119	48.79	0.55	
		9	107	48.78	0.54	
8:30 am	960	10	96	48.82	0.58	
		12	80	48.76	0.52	
		14	69	48.76	0.52	
		16	60	48.79	0.55	
		18	54	48.74	0.50	
	970	20	48	48.74	0.50	
		25	39	48.74	0.50	
		30	32	48.74	0.50	
		35	28	48.71	0.47	
		40	25	48.70	0.46	
9:10 am	1000	45	22	48.70	0.46	
		50	20	48.70	0.46	

RECOVERY READINGS IN WELL NO. 3 AFTER PUMPING TEST

[illegible]

27 November

APPENDIX

READINGS TAKEN ON OBSERVATION WELL NO. 2 DURING
"CONSTANT RATE" PUMPING TEST ON WELL NO. 3

Date 25 November 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	Static level 46.35' below casing Stick up 1.42' Static level 44.93' below ground
3:00 pm	0.0	46.35		pumping well Q = 1500 USgpm
	0.5	47.31	0.96	
	1.0	-		
	1.5	47.45	1.10	
	2.0	47.55	1.20	
	2.5	47.38	1.03	
	3.0	47.53	1.18	
	3.5	47.50	1.15	
	4.0	47.50	1.15	
	4.5	47.40	1.05	
	5.0	47.43	1.08	
	6	47.46	1.11	
	7	47.47	1.12	
	8	47.45	1.10	
	9	47.54	1.19	
	10	47.42	1.07	
	12	47.45	1.10	
	14	47.41	1.06	
	16	47.46	1.11	
	18	47.45	1.10	
	20	47.45	1.10	
	25	47.45	1.10	
3:30 pm	30	47.45	1.10	pumping well Q = 1963 USgpm
	31	48.15	1.80	
	32	48.11	1.76	
	33	47.98	1.63	
	34	48.01	1.66	
	35	48.02	1.67	
	36	48.02	1.67	
	37	48.02	1.67	
	38	47.98	1.63	
	39	48.01	1.66	
3:40 pm	40	48.00	1.65	pump shut down
	42	48.01	1.66	
	44	48.03	1.69	

APPENDIX

READINGS TAKEN ON OBSERVATION WELL NO. 2 DURING "CONSTANT RATE" PUMPING TEST ON WELL NO. 3

Date 25 November 1975

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	
5:50 pm	46 48 50 52 54 56	46.68 46.45 46.43 46.39 46.34 46.35	0.33 0.10 0.08 0.04 -0.01 0.0	well recovers to original static during pump shut down
4:30 pm	0 50 100	47.98 48.00 48.01	1.63 1.65 1.66	pumping well Q = 1837 USgpm
7:00 pm	150 200 250 300 350 400	47.93 48.12 48.15 48.08 48.13 48.18	1.58 1.77 1.80 1.73 1.78 1.83	
2:00	450 500 550 600 650 700	48.09 48.18 48.16 48.21 48.18 48.24	1.74 1.83 1.81 1.86 1.83 1.89	26 November
5:00 am	750 800 850 900	48.23 48.22 48.23 48.23	1.88 1.87 1.88 1.88	
8:20 am	950	48.23	1.88	pump shut off
Total pumping time is taken as 950 minutes because 90 minutes lost for engine repair.				

APPENDIX

RECOVERY READINGS ON OBSERVATION WELL NO. 2 AFTER
CONSTANT RATE PUMPING TEST ON WELL NO. 3

Date 26 November 1975

	Time (t) since start of pumping started in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet	Residual drawdown in well in feet (static =)	
7:20 am	950	0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5	1901 951 634 476 381 317 272 239 212	48.23 47.34 47.26 46.95 46.91 46.86 46.84 46.81 46.78 46.77	1.88 0.99 0.91 0.60 0.56 0.51 0.49 0.46 0.43 0.42	Because of engine shut down, total pumping time is considered as 950 minutes.
	955	5.0 6 7 8 9	191 159 137 119 107	46.74 46.72 46.78 46.69 46.67	0.39 0.37 0.43 0.34 0.32	
8:30 am	960	10 12 14 16 18	96 80 69 60 54	46.66 46.64 46.63 46.62 46.61	0.31 0.29 0.28 0.27 0.26	
8:40 am	970	20 25 30 35	48 39 32 28	46.60 46.59 46.58 46.58	0.25 0.24 0.23 0.23	
9:00 am		40 45	25 22	46.56 46.56	0.21 0.21	
	1000	50 75	20 13.6	46.55 46.52	0.20 0.17	
10:00 am	1050	100 150	10.5 7.3	46.51 46.49	0.16 0.14	
12:20 pm		240 300 370	5 4 3.5	46.44 46.42 46.40	0.09 0.07 0.05	
3:00 pm	1350	400 450	3.4 3.1	46.40 46.40	0.05 0.05	
	1450	500	2.9	46.38	0.03	

APPENDIX

READINGS TAKEN ON WILLIS OBSERVATION WELL DURING
"CONSTANT RATE" PUMPING TEST ON WELL NO. 3

Date 25 November

Time	Time (t) since start of pumping in mins.	Depth to water in well from top of casing in feet	Drawdown in well in feet (static =)	
3:00 pm	0.0	31.83	0.0	Static water level below casing
8:20 am	950	32.84	1.01	26 November Total pumping time taken as 950 minutes because of 90 minutes of pumping lost due to engine shut down.

APPENDIX

RECOVERY READINGS ON WILLIS OBSERVATION WELL AFTER CONSTANT RATE PUMPING TEST ON WELL NO. 3

Date 26 November 1975

	Time (t) since start of pumping in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet	Residual drawdown in well (static =)	Static level 31.83' below casing.
8:20 am	950	0.0	1901	32.84	1.01	
		0.5		32.65	0.82	
		1.0				
		1.5		32.61	0.78	
		2.0		32.60	0.77	
		2.5		32.61	0.78	
		3.0		32.60	0.77	
		3.5		32.60	0.77	
		4.0		32.59	0.76	
		4.5		32.57	0.74	
		5.0		32.57	0.74	
		6		32.55	0.72	
		7		32.56	0.73	
		8		32.54	0.71	
		9		32.53	0.70	
8:30 am	960	10	96	32.52	0.69	
		12	80	32.52	0.69	
		14	69	32.51	0.68	
		16	60	32.50	0.67	
		18	54	32.49	0.66	
		20	48	32.49	0.66	
		25	39	32.47	0.64	
		30	32	32.45	0.62	
		35	28	32.41	0.58	
		40	25	32.42	0.59	
		45	22	32.41	0.58	
9:10 am	1000	50	20	32.39	0.56	

APPENDIX

RECOVERY READINGS ON WILLIS OBSERVATION WELL AFTER
CONSTANT RATE PUMPING TEST ON WELL NO. 3

Date 26 November

	Time (t) since start of pumping in mins.	Time (t') since pumping stopped in mins.	Value of t/t'	Depth to water in well from top of casing in feet	Residual drawdown in well in feet (static =)	
		75	13.6	32.34	0.51	
0:00 am	1050	100	10.5	32.28	0.45	
		150	7.3	32.20	0.37	
		290	4.3	32.11	0.28	
1:20 pm	1250	300	4	32.11	0.28	
		350	3.7	32.06	0.23	
		400	3.3	32.06	0.23	
		450	3.1	32.06	0.23	
4:40 pm	1450	500	2.9	32.03	0.20	
2:00 pm	2730	1780	1.5	31.85	0.02	27 November

APPENDIX G

GRAPHICAL ANALYSIS OF

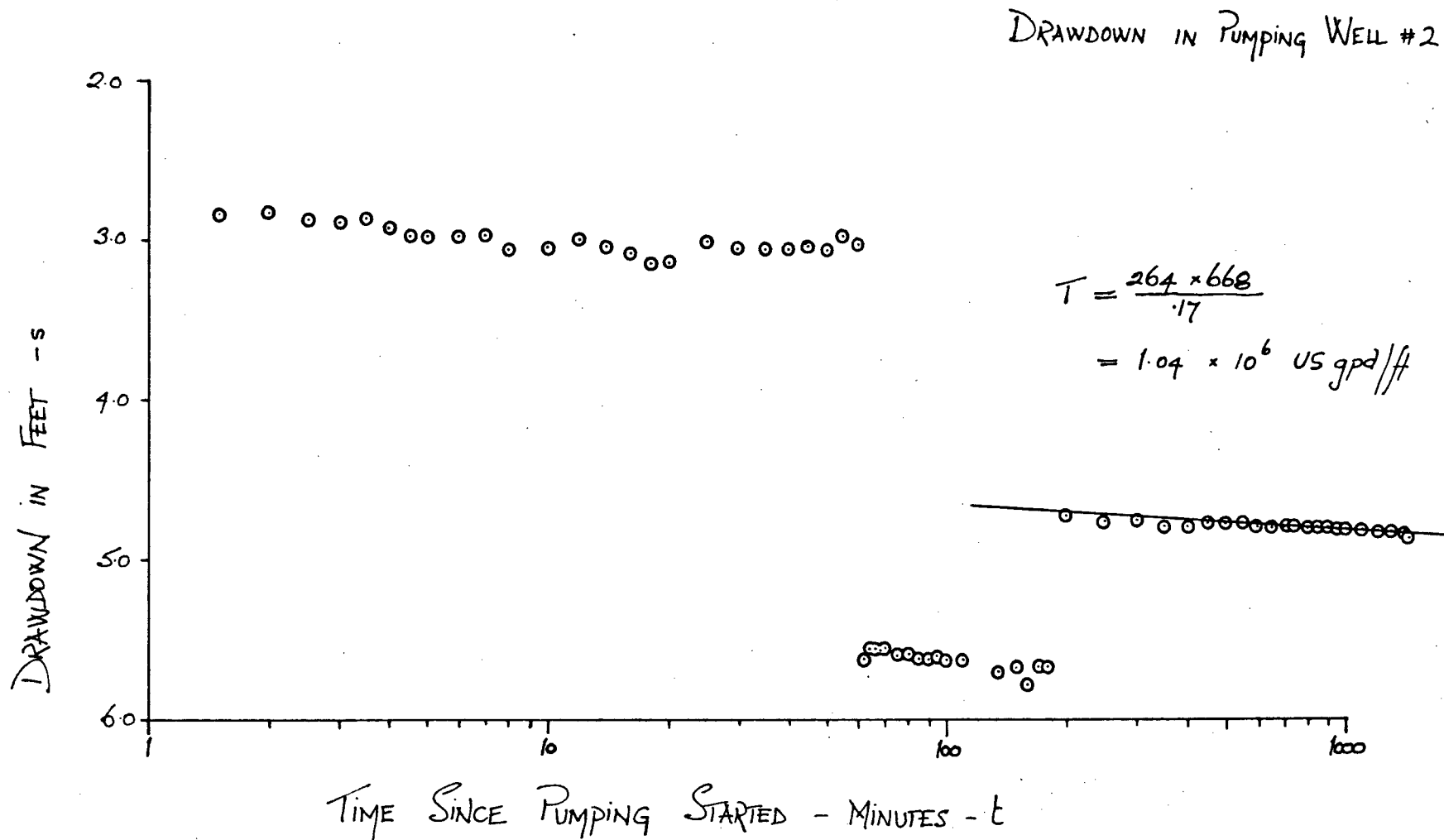
PUMPING TEST DATA

SITE #2

APPENDIX G

WELL #2 Drawdown
Recovery

WELL #3 Drawdown
Recovery
Drawdown - observation well #2
Recovery - observation well #2
Recovery - Willis well
Distance-drawdown



BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.

HOR.

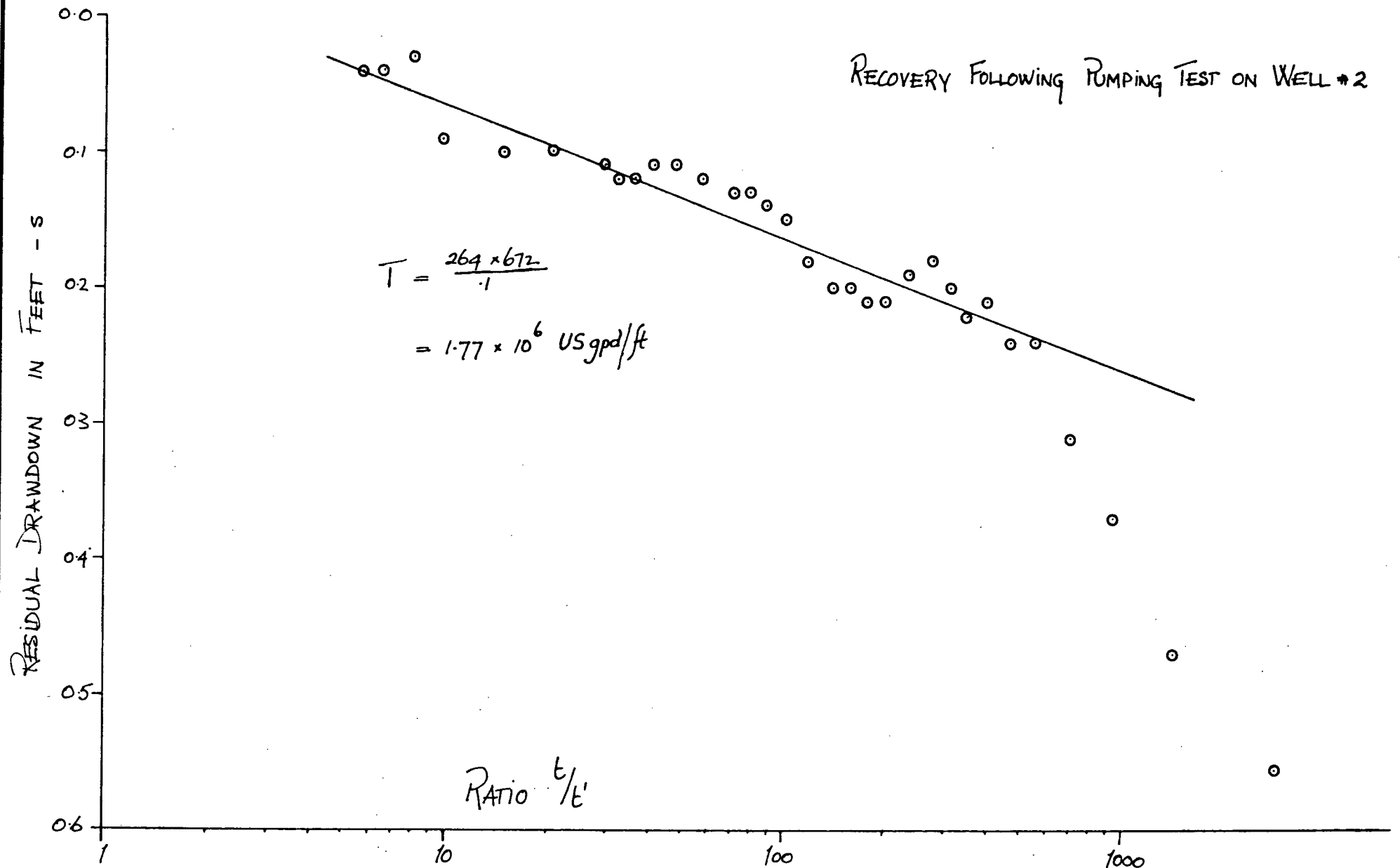
J. M. PETRIE

ENGINEER

FILE No. 0249723 - A

DWG. No.

DATE



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DEPARTMENT OF ENVIRONMENT
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WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

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HOR.

J.M. PETRIE

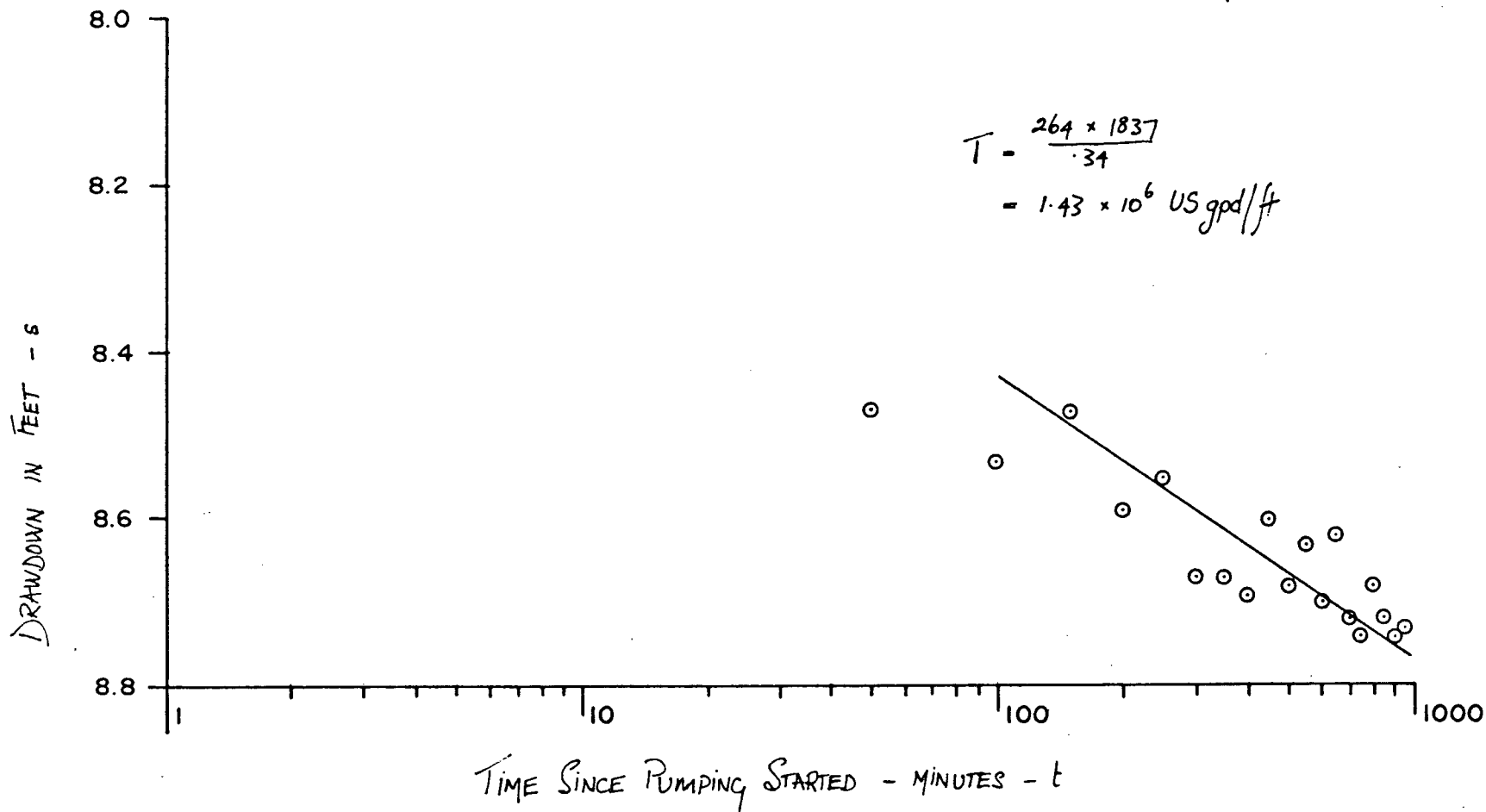
DATE

ENGINEER

FILE No. 0249723-A

DWG. No.

DRAWDOWN IN PUMPING WELL #3



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SCALE: VERT.

HOR.

J.M. PETRIE

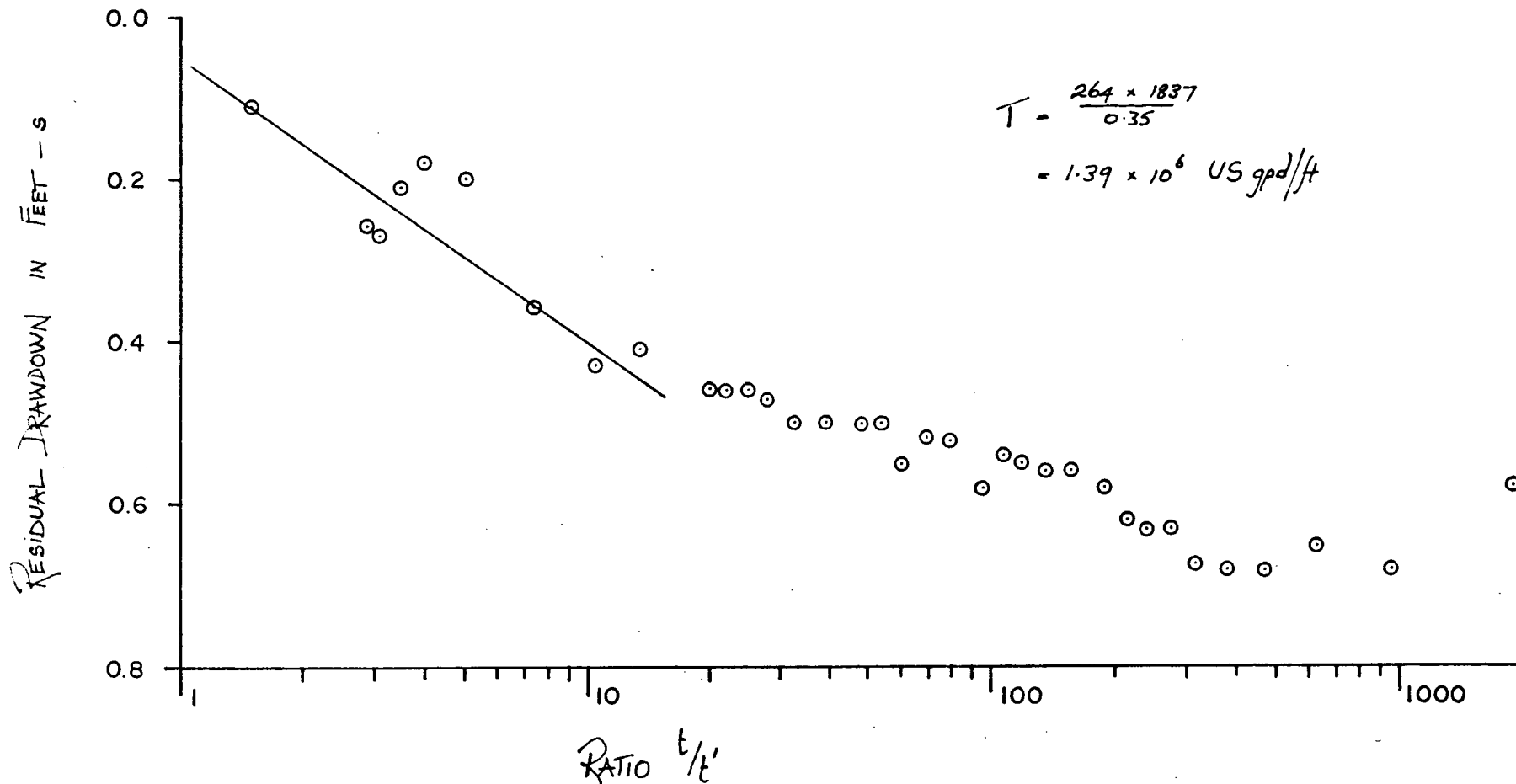
DATE

ENGINEER

FILE No.

0249723 - A

DWG. No.



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FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT. _____

HOR. _____

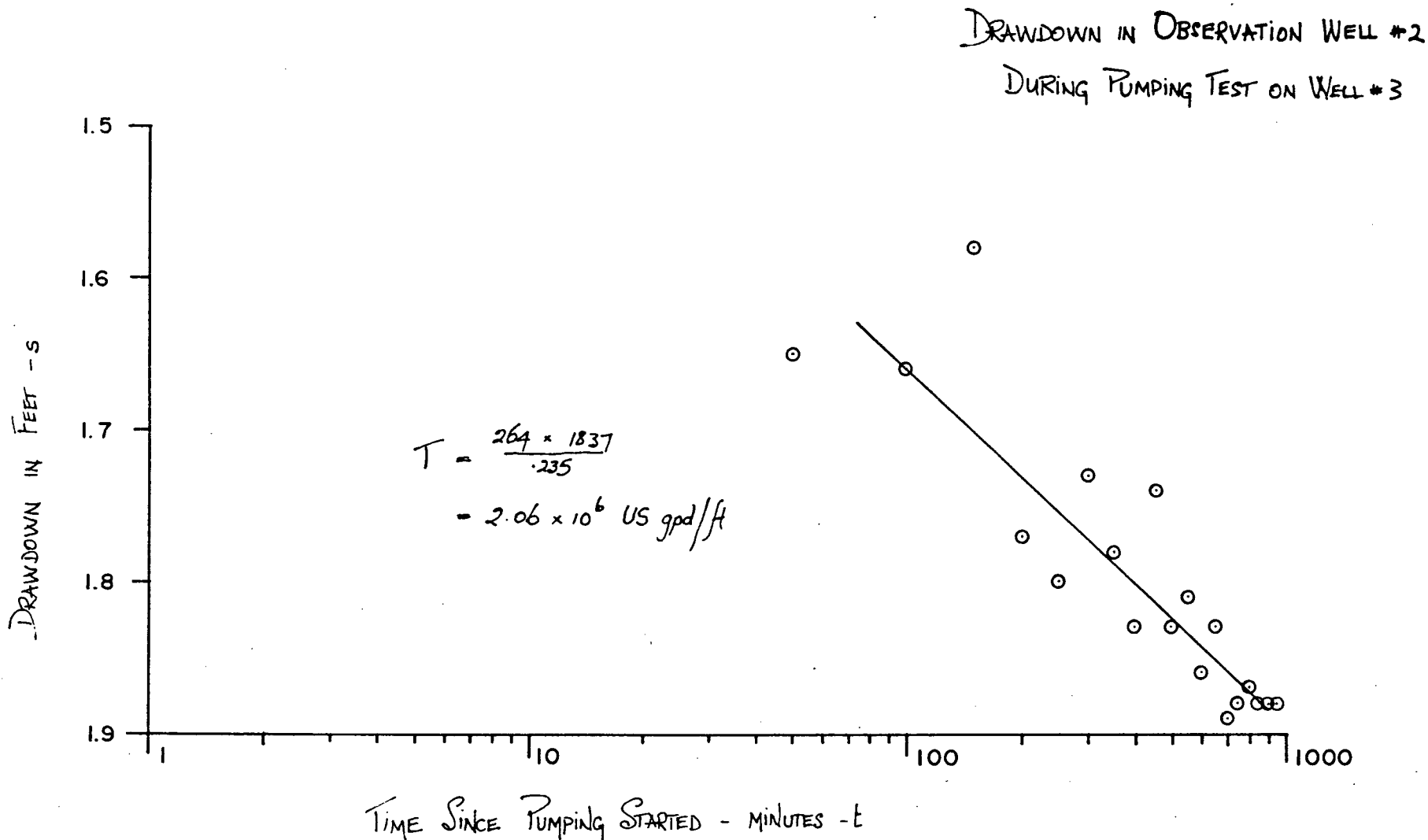
J. M. PETRIE

DATE

ENGINEER

FILE No. 0249723-4

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WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON

FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.....

HOR.....

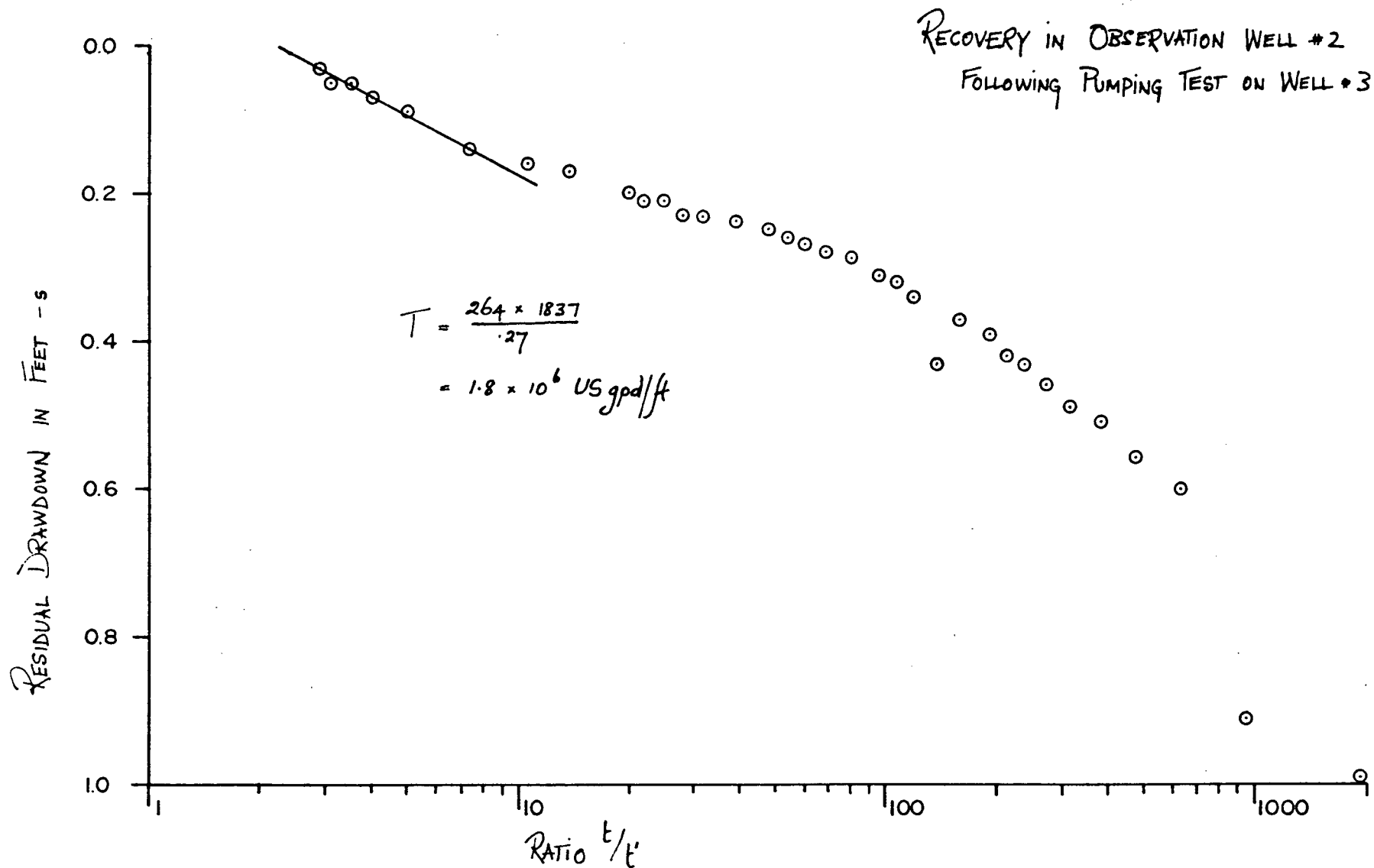
J. M. PETRIE

DATE

ENGINEER

FILE No. 0249723 - A

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SCALE: VERT. _____

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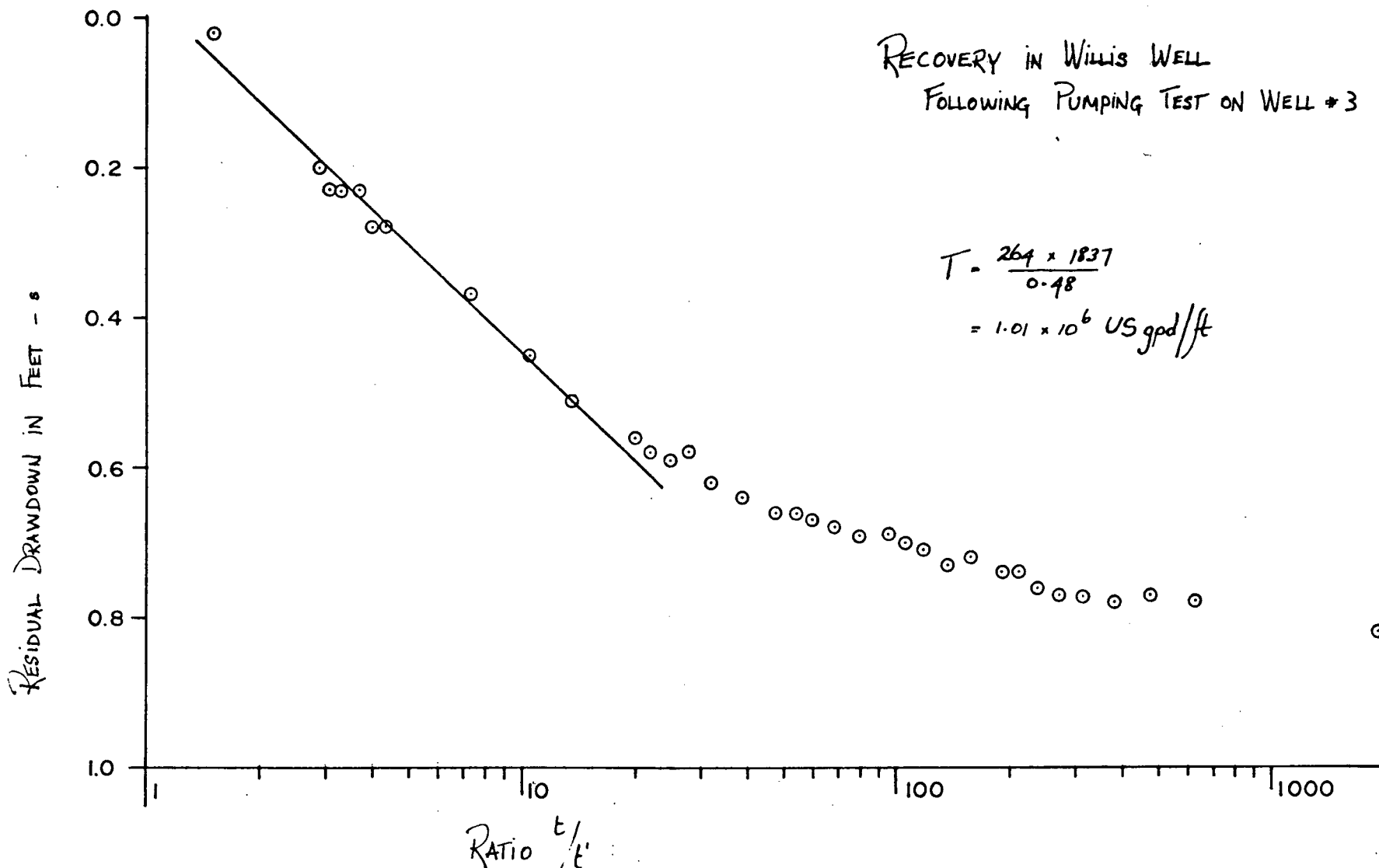
J. M. PETRIE

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TO ACCOMPANY REPORT ON

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SCALE: VERT. _____

HOR. _____

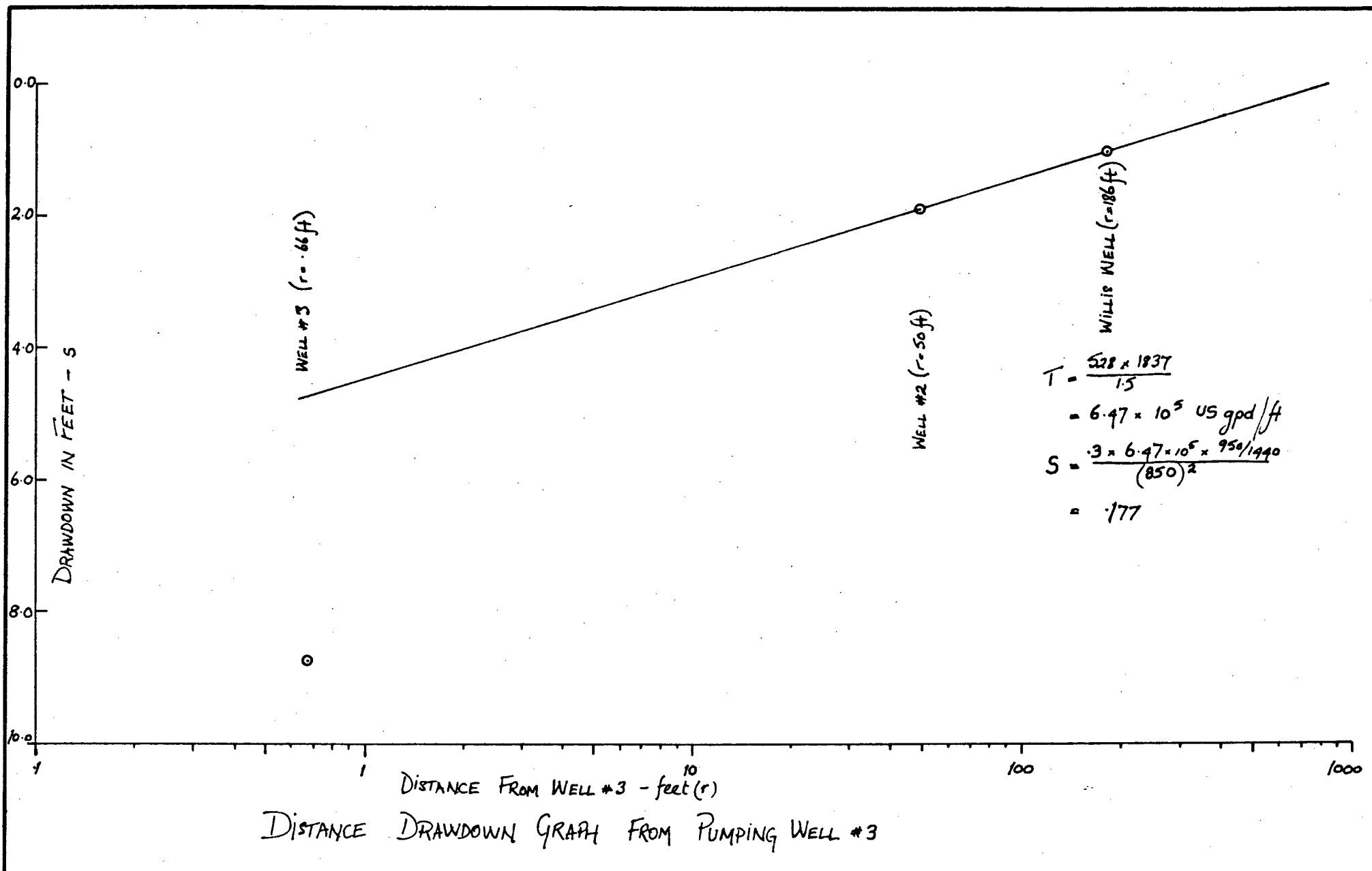
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BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
FAIRVIEW HEIGHTS IRRIGATION DISTRICT

SCALE: VERT.....

HOR.....

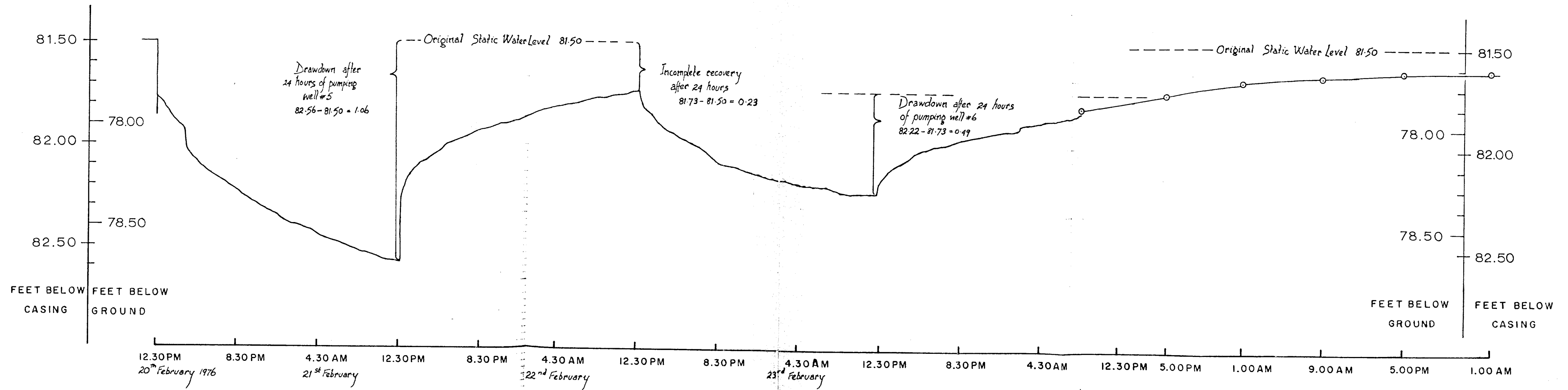
J. M. PETRIE

DATE

ENGINEER

FILE No. 0249723 - A

DWG. No.



Pumping well #5 r = 203 feet
 Q = 678 US gpm
 Q = 1001 US gpm

Pump shut off

Pumping well #6 r = 360 feet
 Q = 1001 US gpm

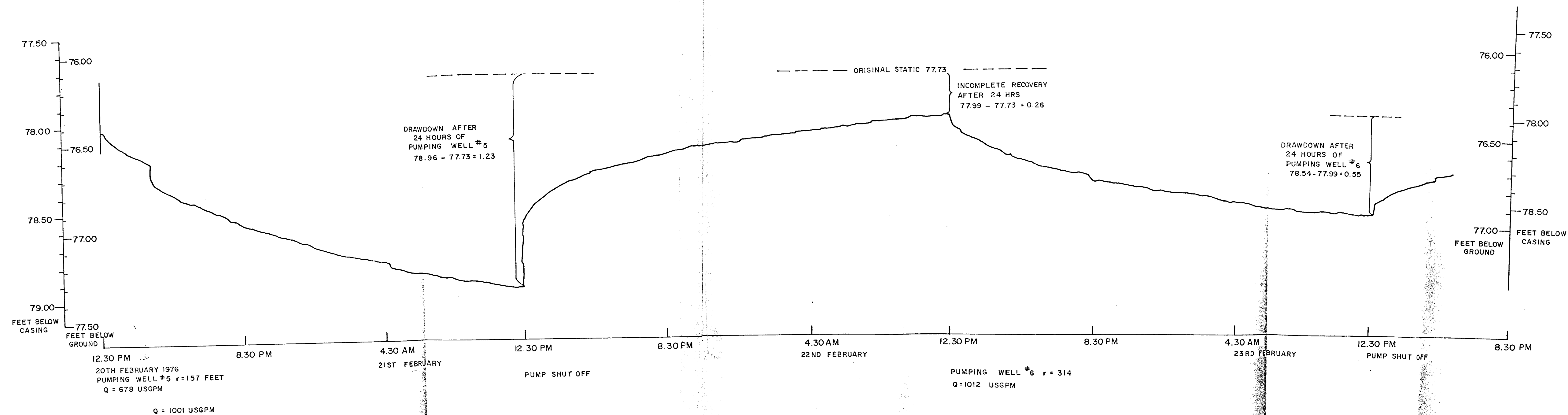
Pump shut off

Data taken from 30 day chart

Data taken from 8 hour chart

HYDROGRAPH FROM WELL #1
 DURING PUMPING TESTS ON WELL #5 AND THEN WELL #6

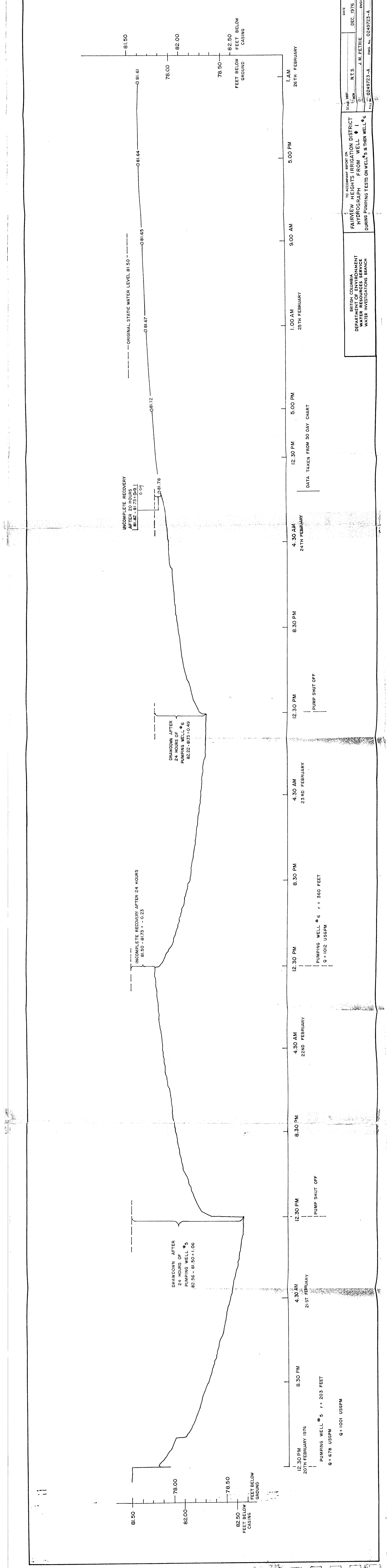
BRITISH COLUMBIA DEPARTMENT OF ENVIRONMENT WATER RESOURCES SERVICE WATER INVESTIGATIONS BRANCH	TO ACCOMPANY REPORT ON		DATE
	FAIRVIEW HEIGHTS		JAN 1977
	IRRIGATION DISTRICT		ENGINEER
	FILE No. 0249723 - A	DWG. No.	



BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

TO ACCOMPANY REPORT ON
FAIRVIEW HEIGHTS IRRIGATION DISTRICT
HYDROGRAPH FROM WELL #4
DURING PUMPING TESTS ON WELL #5 & THEN WELL #6

SCALE: VERT.	DATE
HOR. N.T.S.	DEC. 1976
J. M. PETRIE	ENGINEER
FILE No. 0249723-A	DWG. No. 0249723-A



TO ACCOMPANY REPORT ON
FAIRVIEW HEIGHTS IRRIGATION DISTRICT
HYDROGRAPH FROM WELL # 1
DURING PUMPING TESTS ON WELL #5 & THEN WELL #6

BRITISH COLUMBIA
DEPARTMENT OF ENVIRONMENT
WATER RESOURCES SERVICE
WATER INVESTIGATIONS BRANCH

SCALE: VERT. N.T.S.
HOR. J. M. PETRIE
ENGINEER

DATE DEC. 1976
FILE NO. 0249723-A
DWG. No. 0249723-A