

ARROWCREEK PRODUCTION WELL NO. 3
CONSTRUCTION AND AQUIFER TESTING
SUMMARY REPORT

JULY 1998

WASHOE COUNTY
DEPARTMENT OF PUBLIC WORKS
UTILITY DIVISION

P.O. BOX 11130 RENO, NEVADA 89520



**ARROWCREEK PRODUCTION WELL NO. 3
CONSTRUCTION AND AQUIFER TESTING
SUMMARY REPORT**

JULY 1998

Prepared by:

**WASHOE COUNTY DEPARTMENT
OF WATER RESOURCES
UTILITY SERVICES DIVISION
P.O. BOX 11130
RENO, NEVADA 89520**

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SUMMARY OF WELL DRILLING, CONSTRUCTION, AND AQUIFER TESTING

ArrowCreek Production Well No. 3 was drilled and constructed in April and May 1998. The production well is located in the northwest corner of Section 26, Township 18 north, Range 19 east in southwest Reno, Washoe County, Nevada. The well is constructed of 14-inch diameter casing and wire wrapped screen to a total depth of 700 feet below ground. The well is screened from 440 feet to 700 feet below ground. A blank section is included within the screened interval between 560 and 580 feet below ground. The pump intake should be installed within the blank section when the well is equipped.

Step-drawdown and constant discharge (Q) tests were performed to estimate aquifer properties, well yield, well efficiency, and pumping levels in June 1998. Discharge rates of the step-drawdown test were 400, 500, 600, and 800 gallons per minute (gpm), respectively. The constant Q test was run at a flow rate of 550 gpm for 72 hours. The production well had a drawdown of 126.94 feet with a pumping level of 458.40 feet below ground at the end of the constant Q test. Specific capacity of the well was 4.33 gpm per foot of drawdown at the end of pumping.

Ground water was sampled from ArrowCreek Production Well No. 3 on June 19, 1998 after pumping continuously for approximately 50 hours. Water quality analytical results indicate that the ground water is good quality. No water constituents were detected above primary or secondary standards.

Based on data from the step and constant discharge tests, the recommended long-term pumping rate is 500 gpm with a pumping level of 465 feet below ground. Drawdown in the well is projected to be approximately 133 feet after 30 days of continuous pumping at 500 gpm. The pump intake should be set in the blank casing located between 560 and 580 feet below ground.

INTRODUCTION

This report describes well drilling and aquifer testing for ArrowCreek Production Well No. 3. A monitoring well was drilled and constructed near the production well site in July 1992. Information pertaining to the monitoring well drilling, including a lithologic log, are described in the Washoe County report Mt. Rose Fan Exploratory Drilling, dated July-August 1992. ArrowCreek Production Well No. 3 is located in the northwest corner of Section 26, Township 18 north, Range 19 east, in southwest Reno, Washoe County, Nevada (Figure 1). Screen size was selected after a sand (sieve) analysis was completed on borehole cutting samples collected at the well site. Step-drawdown and constant discharge (Q) pumping tests were performed to determine aquifer characteristics. The step-drawdown test ran for 400 minutes at four different flow rates. Flow rates for the step test were 400, 500, 600, and 800 gpm, respectively. The constant Q test was run continuously for 72 hours. Flow rate for the constant Q test was 550 gpm. Recovery data were obtained after completion of the constant Q pumping test. A ground water sample was collected from the well during the constant Q test. The sample was collected after pumping the well for approximately 50 hours. The sample was analyzed for all regulated and some unregulated organic and inorganic compounds at two laboratories. The well was also tested for sand content during pumping tests using a Rossum sand tester.

BOREHOLE DRILLING AND WELL CONSTRUCTION FOR ARROWCREEK PRODUCTION WELL NO. 3

Drilling and construction of ArrowCreek Production Well No. 3 was completed by Layne Christensen in April and May 1998. A monitoring well is located approximately 400 feet from the production well. Approximate locations of the wells are shown in Figure 1. Approximate locations for the wells based on state plane coordinates are:

ArrowCreek Production Well No. 3 -	Latitude	119° 49' 27.24"
	Longitude	39° 24' 11.35"
ArrowCreek Monitoring Well -	Latitude	119° 49' 28.42"
	Longitude	39° 24' 14.50"

Drilling was completed by the direct rotary method with circulation of a bentonite (mud) slurry. The mud slurry transfers drill cuttings to the surface, passes through a self-contained mud system to remove the cuttings before re-circulating down the borehole. Tri-cone bits were used to drill the borehole.

Initially, the contractor drilled a pilot hole with a 12 ¼ - inch bit to a total depth of 720 feet below ground. Samples of drill cuttings were collected at 10-foot intervals during drilling of the pilot hole. The contractor reamed the pilot hole with a 20-inch and a 28-inch bit to 105 feet below ground to set the conductor casing. The conductor casing was 22 inches inside diameter and was sealed with a sand-cement grout or slurry mixture. The borehole was reamed to 725 feet below ground with the 20-inch bit after the conductor casing was allowed to cure for 24 hours.

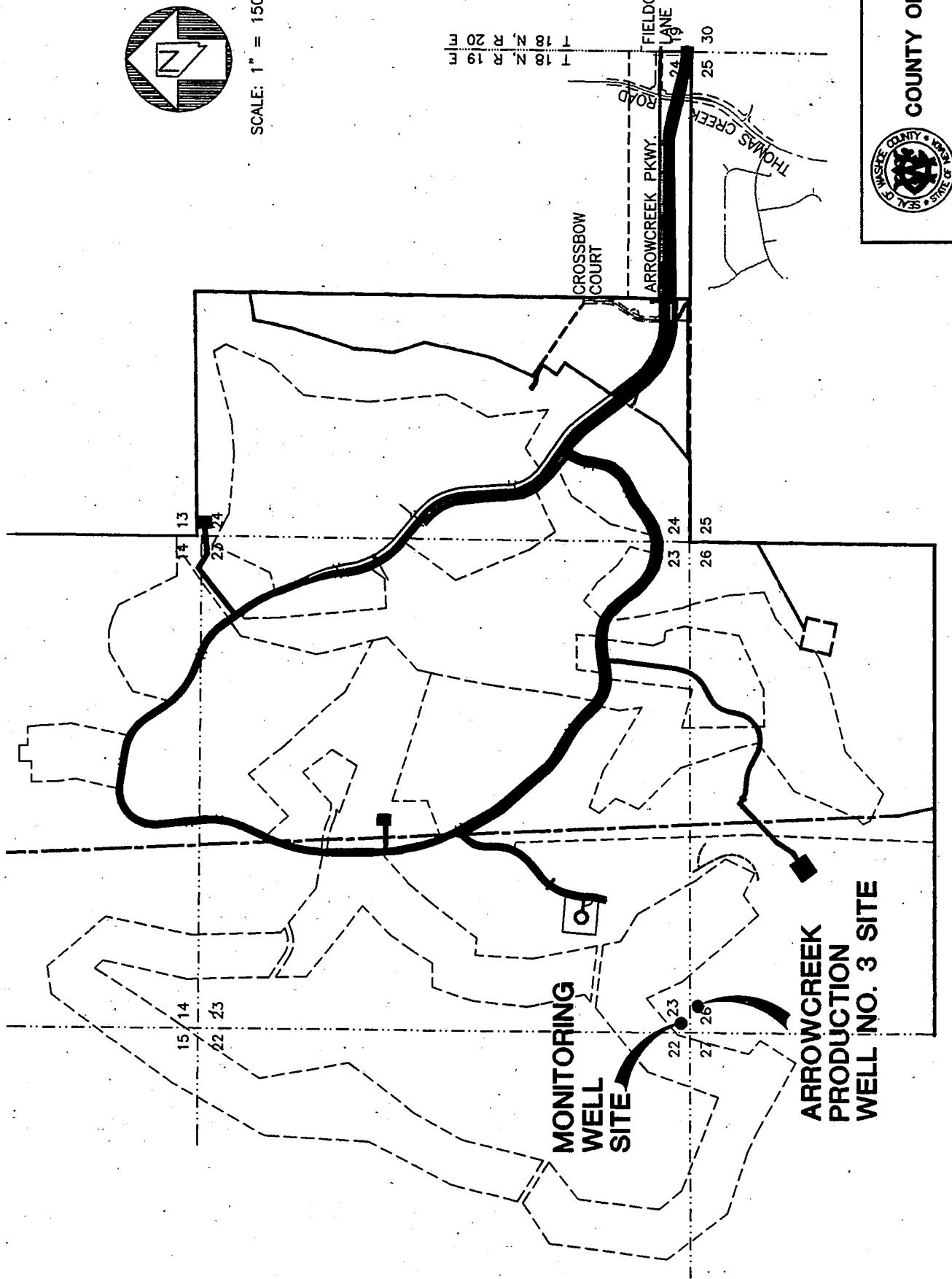


FIGURE 1
**SITE LOCATION MAP OF ARROWCREEK
PRODUCTION WELL NO. 3**

Department of **UTILITY SERVICES DIVISION**
4930 ENERGY WAY
RENO, NEVADA 89520
(702)954-4600

Map by Paragon

Table 1 outlines borehole depths and diameters, well casing and screen lengths and diameters, depth of screen placement, and lengths of sanitary grout seals and gravel pack. A copy of the well drilling report is included in Appendix I.

TABLE 1. SUMMARY OF BOREHOLE DRILLING AND WELL CONSTRUCTION FOR ARROWCREEK PRODUCTION WELL NO. 3.

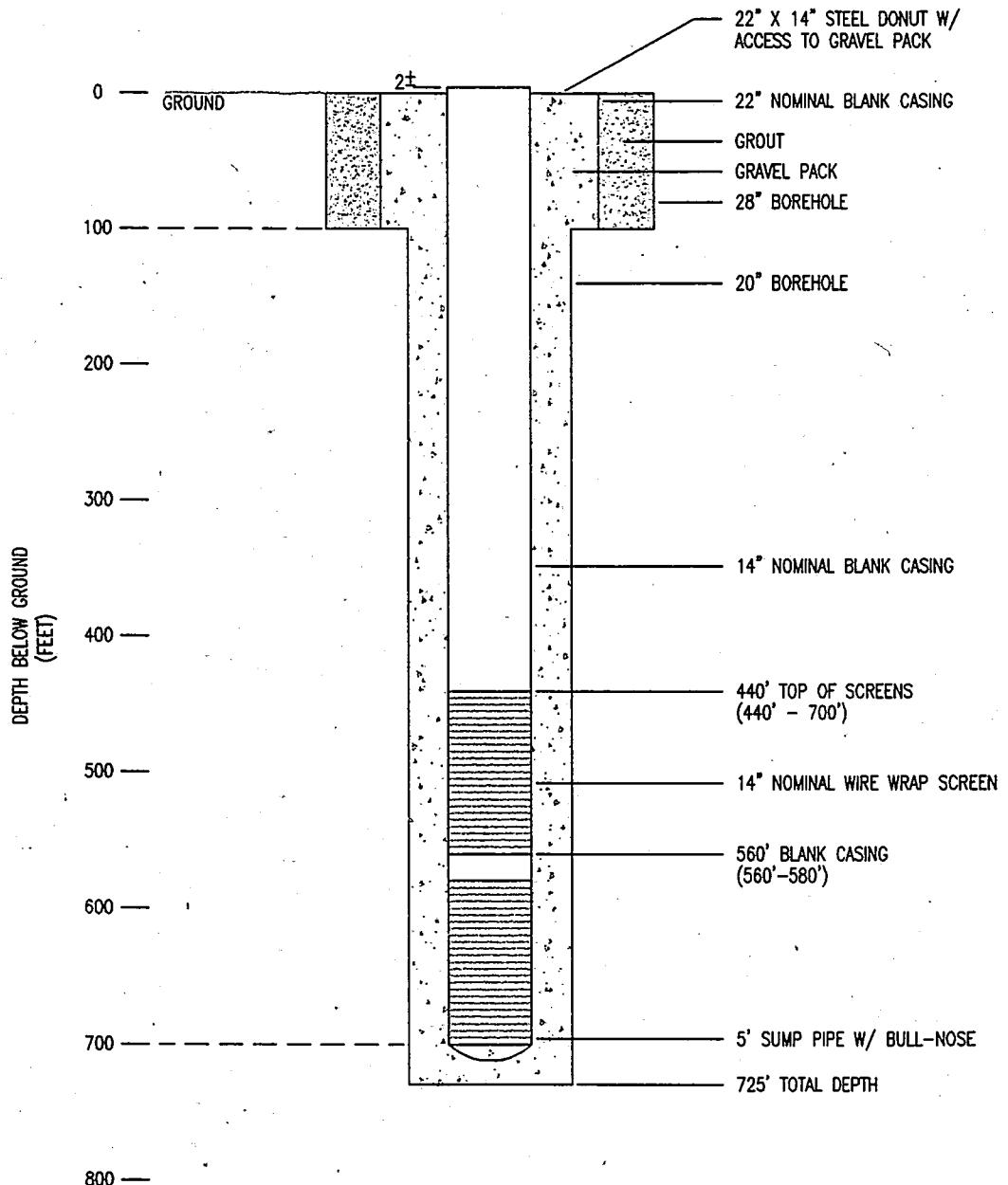
Pilot hole diameter, length	12 ¼ inches, 720 feet
Conductor casing hole diameter, length	28 inches, 105 feet
Conductor casing nominal diameter, length	22 inches, 100 feet
Well borehole diameter, length	20 inches, 725 feet
Blank casing nominal diameter, interval	14 inches, +2 to 440 feet 560 to 580 feet 700 to 705 feet
screen inside diameter, interval	14 inches, 440 to 560 feet 580 to 700 feet
Cement grout seal interval	0 to 105 feet
gravel pack interval	0 to 725 feet

A copy of the well drilling report is included in Appendix I.

Screen type for the production well is wire wrapped with 0.080-inch (80 slot) perforations. Results of the sieve analysis, used to determine the perforation size, are included in Appendix II. Gravel pack and the grout seal were placed using a tremie pipe. Gravel pack was 1/4-inch by 1/8-inch diameter gravel. Figure 2 details the as-built designs of ArrowCreek Production Well No. 3.

WELL DEVELOPMENT

ArrowCreek Production Well No. 3 was developed by air lifting and swabbing, and by pumping. The well was periodically air lifted or pumped, allowed to recover, then air lifted or pumped again. Approximately 150 hours were needed to develop the well adequately.



DEPARTMENT OF PUBLIC WORKS



UTILITY DIVISION
P.O. BOX 11130
RENO, NEVADA 89520
(702) 954-4600

ARROWCREEK PRODUCTION WELL #3

FINAL WELL DESIGN

FIGURE 2

AQUIFER TESTS

Aquifer tests help obtain the hydraulic parameters of the aquifer which are used to determine long-term yields of production wells. Goals of the aquifer tests on ArrowCreek Production Well No. 3 were:

- 1) Determine pumping levels of the well at different discharge rates;
- 2) Determine aquifer transmissivity, the related hydraulic conductivity, and storativity or specific yield;
- 3) Determine if any aquifer recharge or no-flow boundaries exist near the well; and,
- 4) Use the results of the aquifer tests to determine a production rate that will maintain a pumping level near the top of the screened interval, even if the well is pumped continuously over a relatively long period of time (30 days).

Aquifer Testing Equipment and Setup

A large horsepower inline turbine pump was installed in the well for the step-drawdown and constant Q tests. A trailer-mounted diesel engine was the power source for the pump. The pump intake was set at 560 feet below ground surface. Static water level was 336.41 feet below ground surface before start-up of the step-drawdown test.

Discharge rates were measured with an orifice weir. The weir consisted of an 8-inch diameter horizontal discharge pipe, a 5-inch diameter orifice plate, and a manometer. Flow rates were adjusted with a gate valve. Figure 3 shows the setup of the orifice weir and gate valve. The Rossum sand tester was located near the elbow connection of the well head and horizontal discharge pipe where the discharge water becomes turbulent.

Discharge water was piped away from the pumping well to a small pond. The pond minimized disturbance and erosion of the ground and subsequent transport of sediment down slope.

Water levels were measured in the pumping well and monitoring well using a Hermit SE1000C electronic data logger. Water levels also were measured periodically with a battery powered water level indicator.

Summary of Aquifer Tests

Types and duration of the pumping tests completed for ArrowCreek Production Well No. 3 are summarized in Table 2.

From Ground Water and Wells by Johnson Filtration Systems Inc., 2nd Edition, 1986 - 1989.

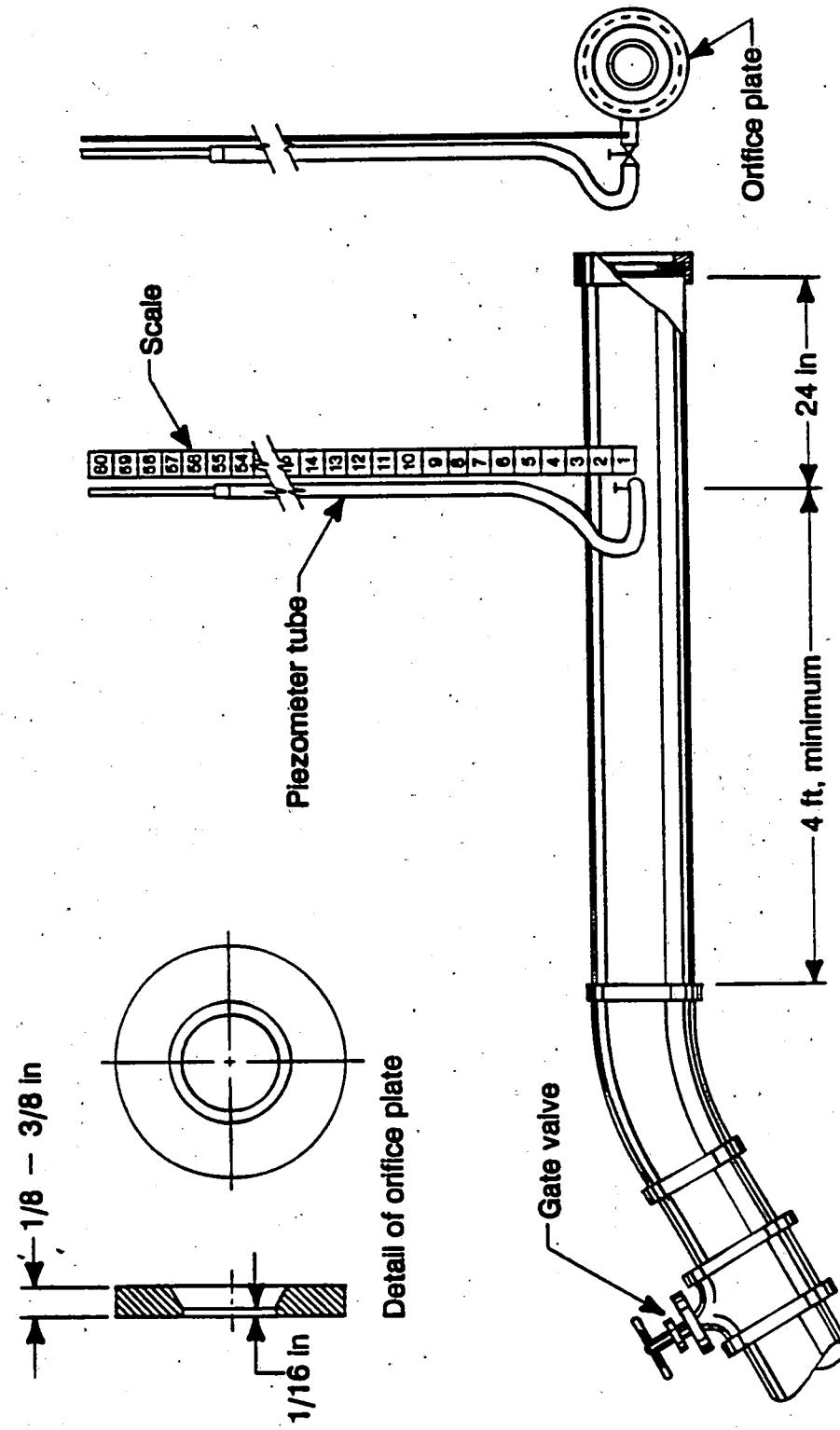


Figure 3. Orifice Weir Set-Up

TABLE 2. SUMMARY OF AQUIFER TESTS PERFORMED FOR ARROWCREEK PRODUCTION WELL NO. 3.

TEST TYPE	DATE	START TIME	END TIME	DURATION (minutes)	DISCHARGE RATES (gpm)
Step-Drawdown	06/14/98	0900	1540	400	400, 500, 600, 800
Constant Q	06/17/98 to 06/20/98	0945	0945	4320	550
Recovery	06/20/98 to 06/23/98	0945	1425	4600	-

gpm = discharge rates in gallons per minute.

The step-drawdown test was performed to determine pumping levels, well yield, specific capacity, and well efficiency for the production well at different discharge rates. Information from the step-drawdown test was used to select a discharge rate for the constant Q test. The constant Q and recovery tests were completed to determine aquifer parameters such as transmissivity, hydraulic conductivity, storativity, and boundary effects. Copies of field data sheets with time-drawdown and recovery data are included in Appendix III.

AQUIFER TEST DATA ANALYSIS

Step-drawdown data were analyzed according to the method of Jacob (1947). Table 3 summarizes the step-drawdown data for the pumping well.

TABLE 3. STEP-DRAWDOWN DATA AND CALCULATED SPECIFIC CAPACITIES AND SPECIFIC DRAWDOWNS FOR ARROWCREEK PRODUCTION WELL NO. 3.

Step Number (n)	Well Yield (Q _n)	Drawdown @ 100 Minutes (S _n)	Specific Capacity (Q _n /S _n)	Specific Drawdown (S _n /Q _n)
1	400	58.18	6.88	0.1455
2	500	79.29	6.31	0.1586
3	600	101.13	5.93	0.1686
4	800	142.46	5.62	0.1781

Q_n = gallons per minute (gpm)

S_n = feet (ft)

Figure 4 shows the drawdown versus time data on a semi-log graph for the step-drawdown data. Well efficiency (E) at various flow rates were calculated by plotting specific drawdown versus Q to determine values of B and C from the plotted data. B is the y-intercept of the "best fit" line passing through the plotted data points and c is the slope of the "best fit" line. Figure 5 is a graph of the specific drawdown versus Q data. Well efficiency is then calculated using the equation

$$E = \frac{1}{1 + (C/B)Q}$$

Formation loss and well loss are calculated using the equation

$$Sw = BQ + CQ^2 \text{ where,}$$

BQ is the formation loss, and
CQ² is the well loss.

Values of E and Sw are summarized in Figure 6.

AQUIFER PARAMETER ESTIMATIONS

Transmissivity and specific yield are used for analysis of well hydraulics in unconfined aquifers where flow is presumed to be two dimensional and horizontal.

Transmissivity (T) is the parameter representing the rate that water moves through a cross-sectional width of an aquifer. T values are the product of aquifer hydraulic conductivity (k) and aquifer thickness (b), or

$$T = kb.$$

T values are needed to estimate well yield and drawdown, and are expressed as gallons per day per foot of drawdown (gallons • feet / day) in this report. T values for ArrowCreek Production Well No. 3 were estimated using the Cooper-Jacob straight line (graphical) method and the software program Well Hydraulics Interpretation Program, WHIP (Hydro Geo Chem, Inc., 1987, 1988). Table 4 summarizes the T values obtained from these two methods. Both drawdown and recovery data were evaluated to estimate T.

Storativity (s) is the aquifer parameter representing the volume of water that an aquifer releases from storage per unit surface area of aquifer per unit decline in hydraulic head perpendicular to that surface.

FIGURE 4. PUMPING WELL DRAWDOWN DATA FROM STEP TEST.

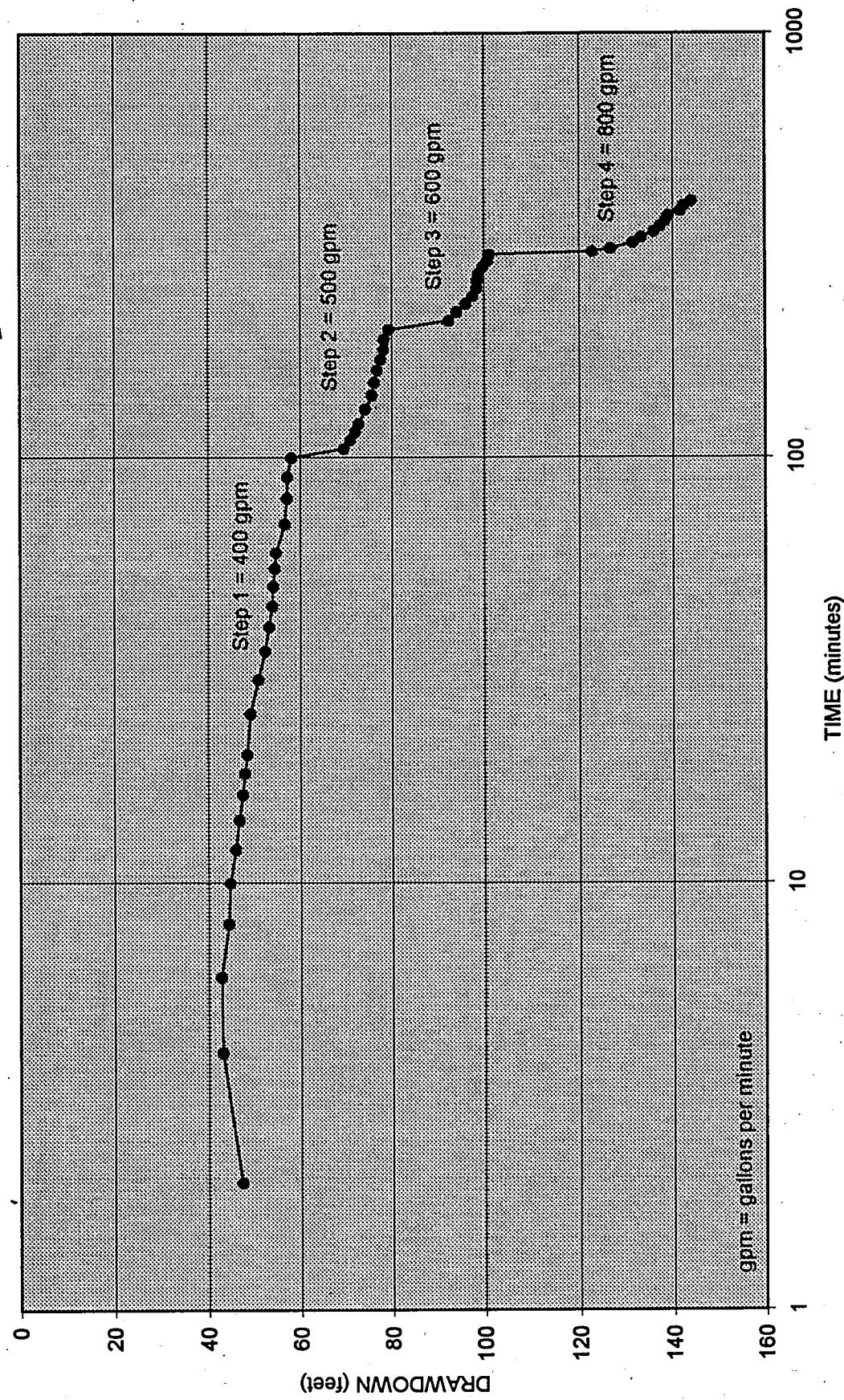


FIGURE 5. GRAPH OF SPECIFIC DRAWDOWN VERSUS WELL YIELD FROM STEP TEST

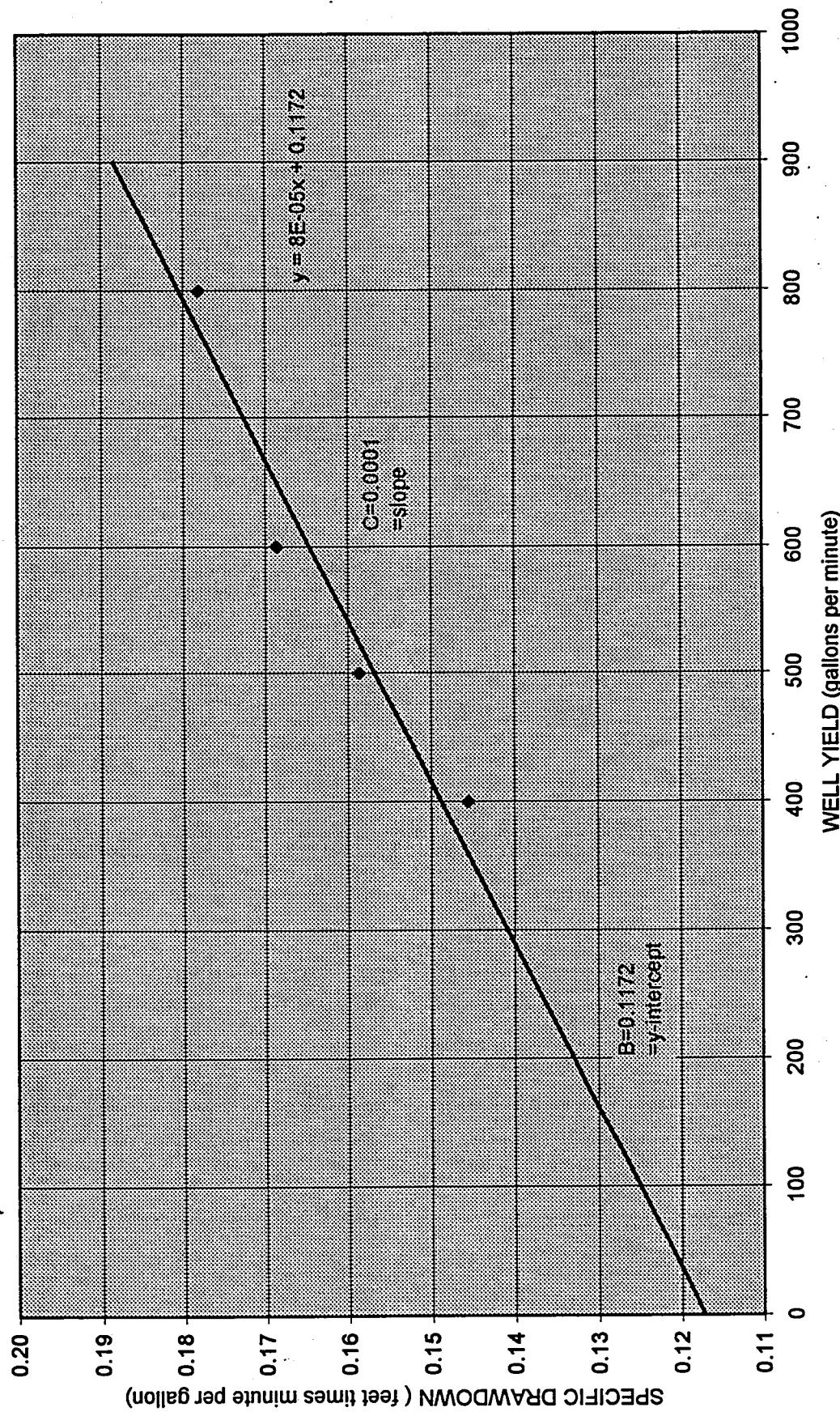
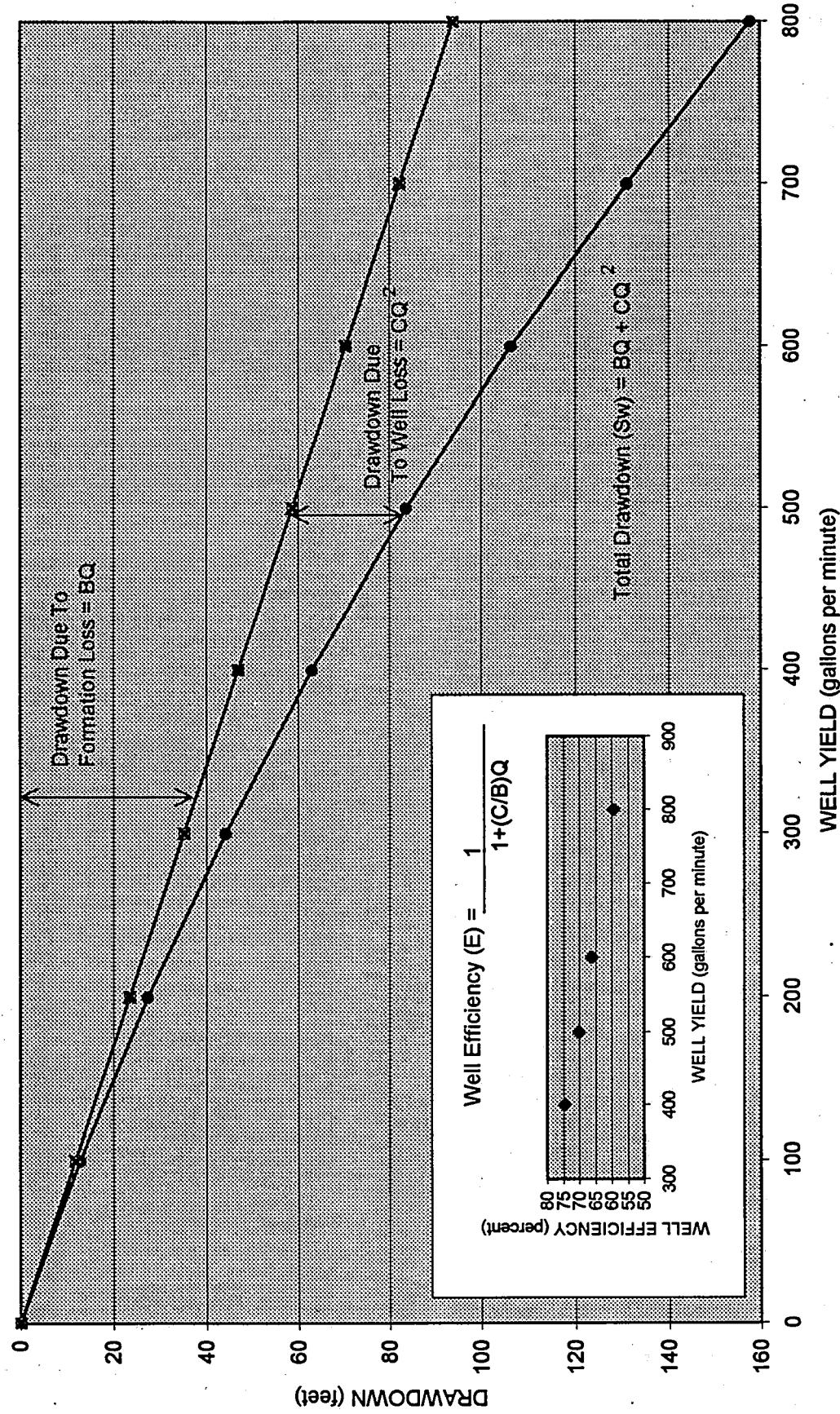


FIGURE 6. GRAPH OF TWO COMPONENTS OF DRAWDOWN: WELL LOSS AND FORMATION LOSS



The equation to determine storativity is

$$s = \frac{(0.3T t_0)}{r^2}$$

where,

T is transmissivity in gallons • feet / day;

t_0 is time when Cooper-Jacob straight line has zero drawdown; and,

r is the distance from the pumping well to the monitoring well.

Table 4 includes the computed s values for ArrowCreek Production Well No. 3 aquifer tests. It should be noted that s values derived from data collected in pumping wells generally are not reliable. The s values computed by WHIP for the ArrowCreek well match reasonably well with a value computed from a monitoring well located approximately 3,000 feet away during a previous aquifer test. The s value from the previous aquifer test is 0.001.

TABLE 4. SUMMARY OF TRANSMISSIVITY AND STORATIVITY VALUES
ESTIMATED FROM ARROWCREEK PRODUCTION WELL NO. 3 CONSTANT
DISCHARGE AND RECOVERY DATA.

DATA TYPE	GRAPHICAL T	WHIP T	GRAPHICAL s	WHIP s
Drawdown	5,497	5,385 to 5,834	-	0.030 to 0.064
Recovery	6,453	5,295 to 6,275	-	0.030 to 0.050

T = transmissivity in gallons • feet / day.

s = storativity, no units

Figures 7 through 12 are graphs with drawdown and recovery data for each well measured during the constant Q and recovery tests.

The monitoring well data was not used to calculate aquifer parameters since there was minimal drawdown in the well. The monitoring well was vandalized and plugged with debris and appears to show partial penetration effects. The well was air blown and cleaned out but may not be completely free of debris.

WATER QUALITY

One ground water sample was collected from ArrowCreek Production Well No. 3 on June 19, 1998. The sample was collected after the well had pumped for approximately 50 hours at a pumping rate of 550 gpm. No water constituents were detected above primary or secondary drinking water standard maximum contaminant levels. Appendix IV includes copies of the laboratory analytical data.

FIGURE 7. PUMPING WELL DRAWDOWN AND RECOVERY DATA

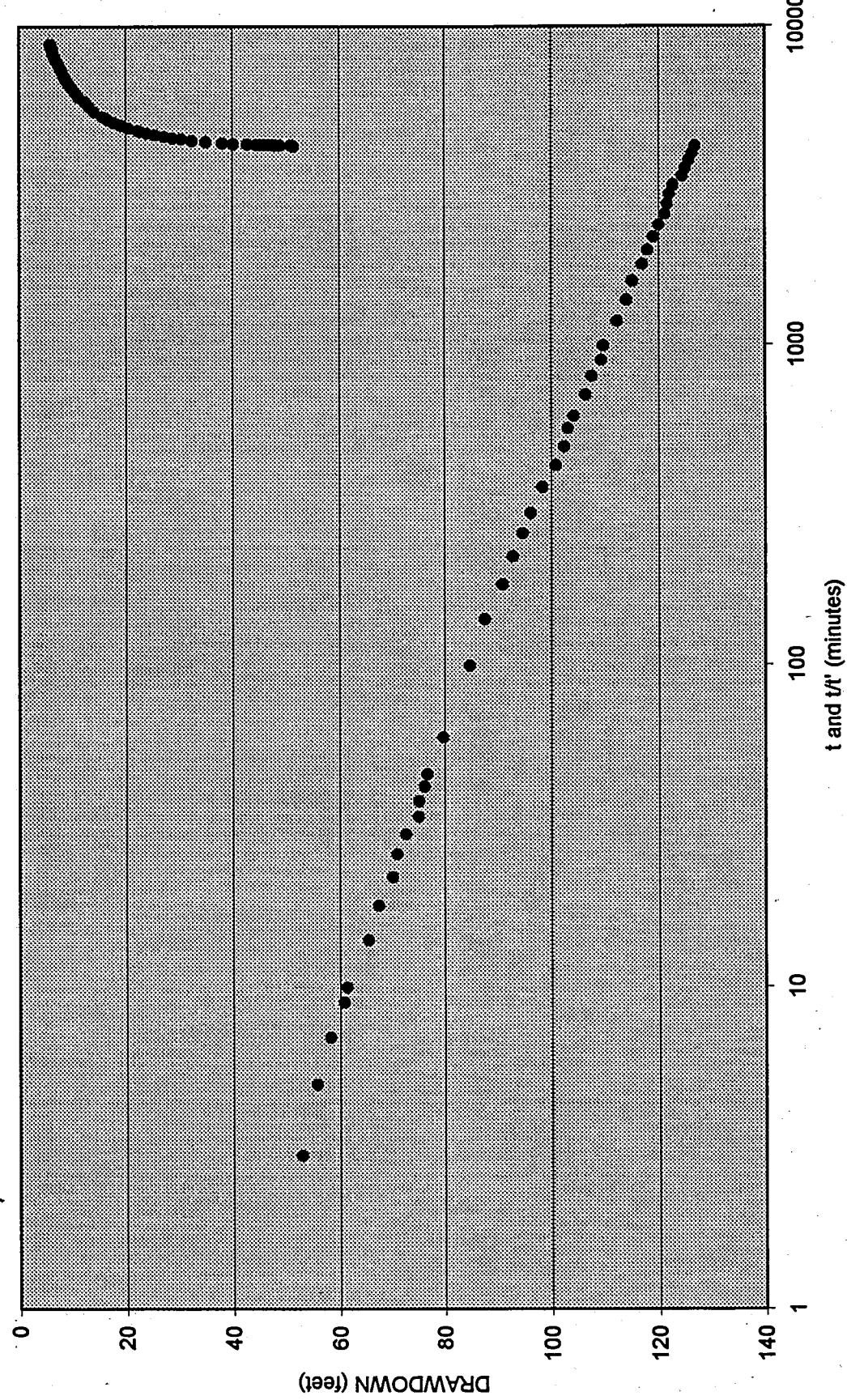


FIGURE 8. PUMPING WELL DRAWDOWN DATA FROM CONSTANT DISCHARGE TEST

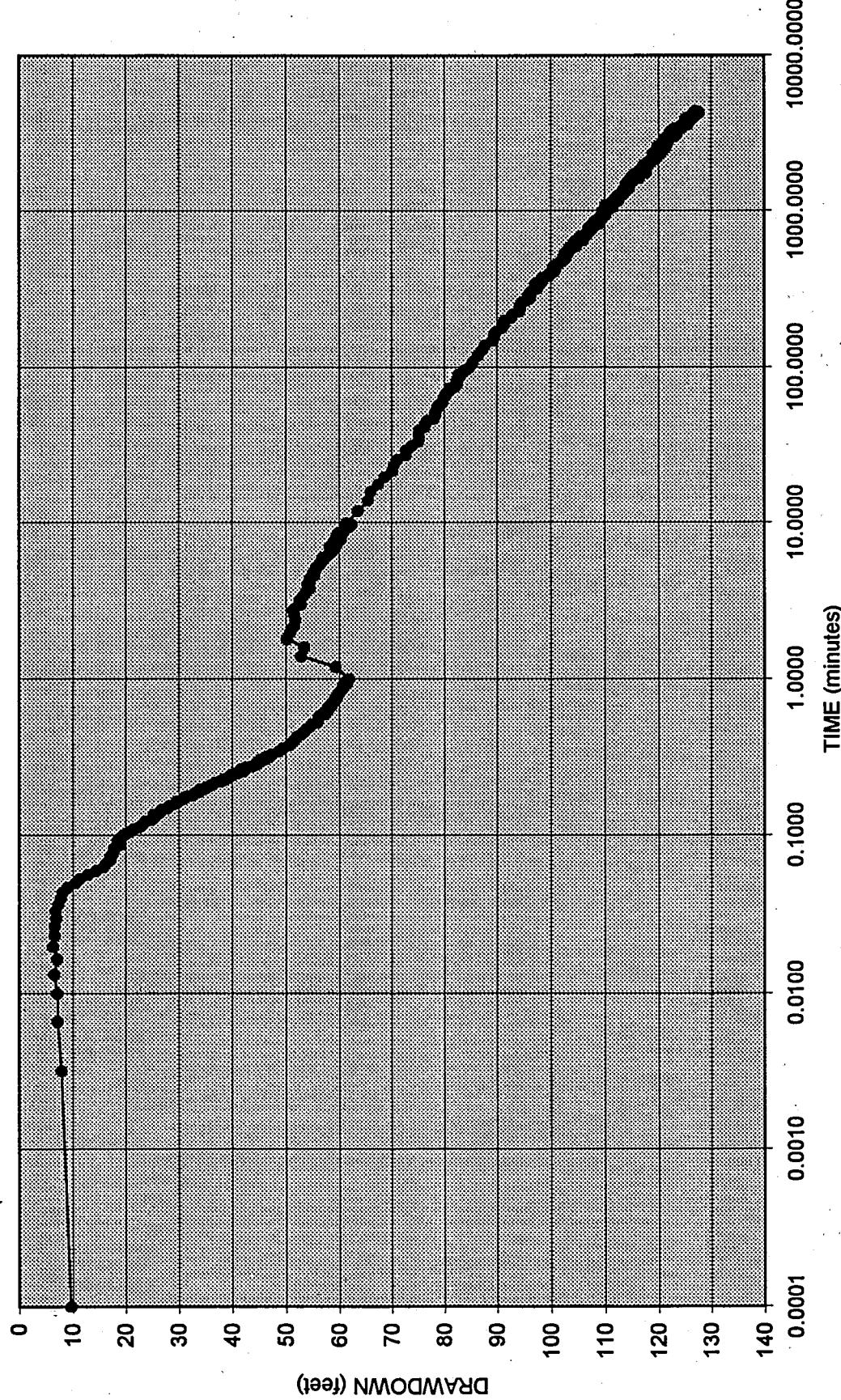
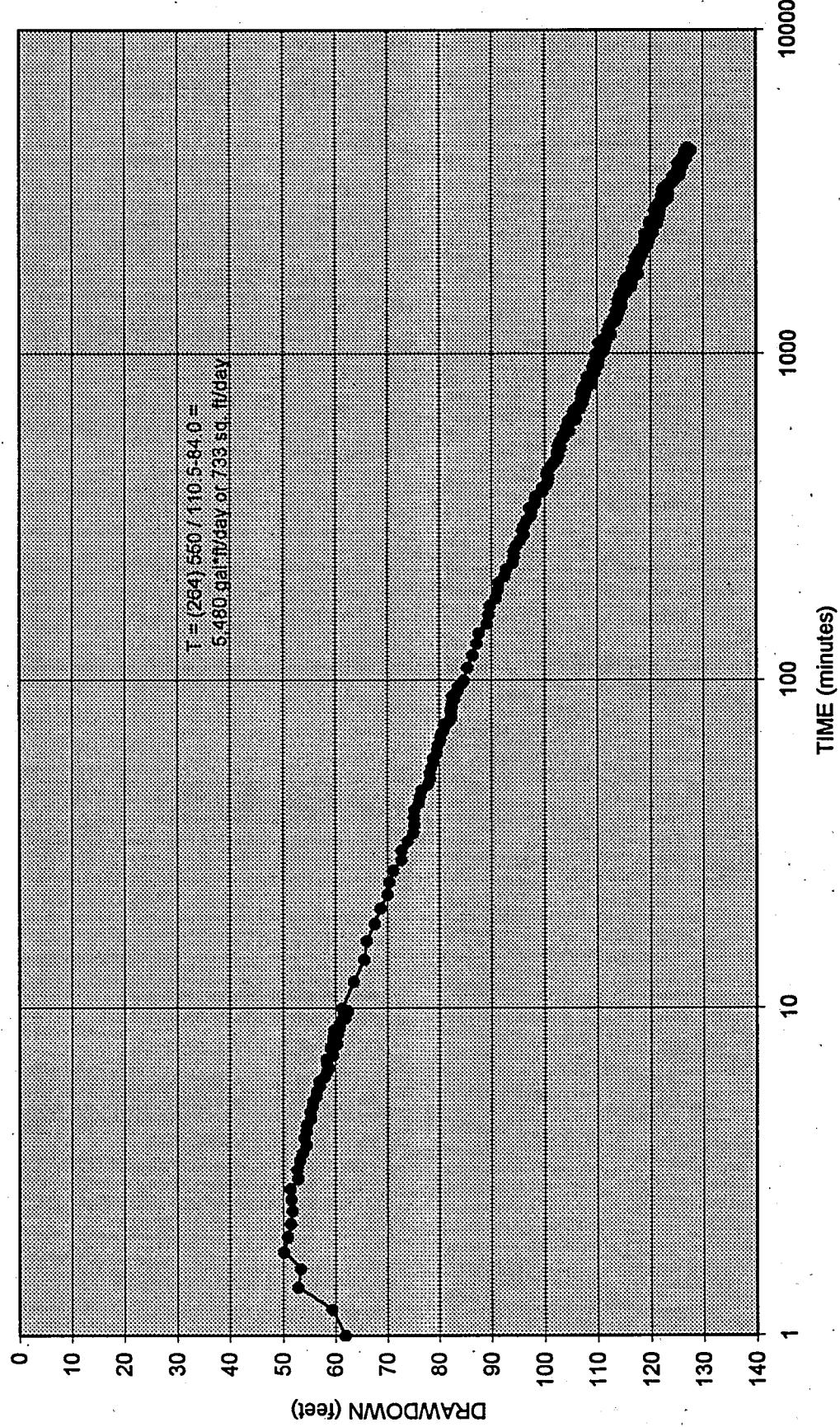


FIGURE 9. PUMPING WELL DRAWDOWN DATA FROM CONSTANT DISCHARGE TEST STARTING WITH
TIME (t) = 1 MINUTE.



ARROWCREEK PRODUCTION WELL NO. 3
FIGURE 10 . MONITORING WELL DRAWDOWN DATA FROM CONSTANT DISCHARGE TEST

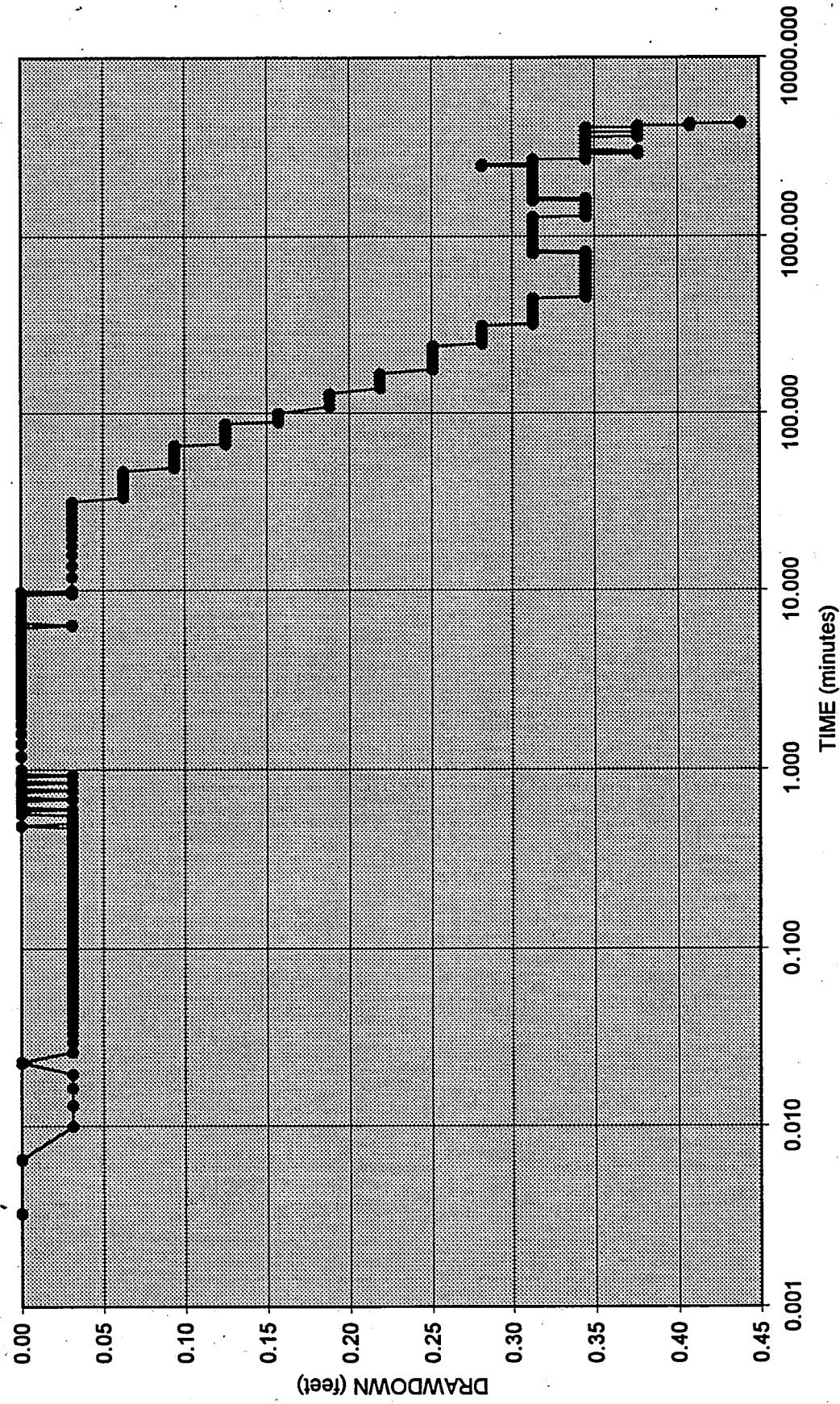
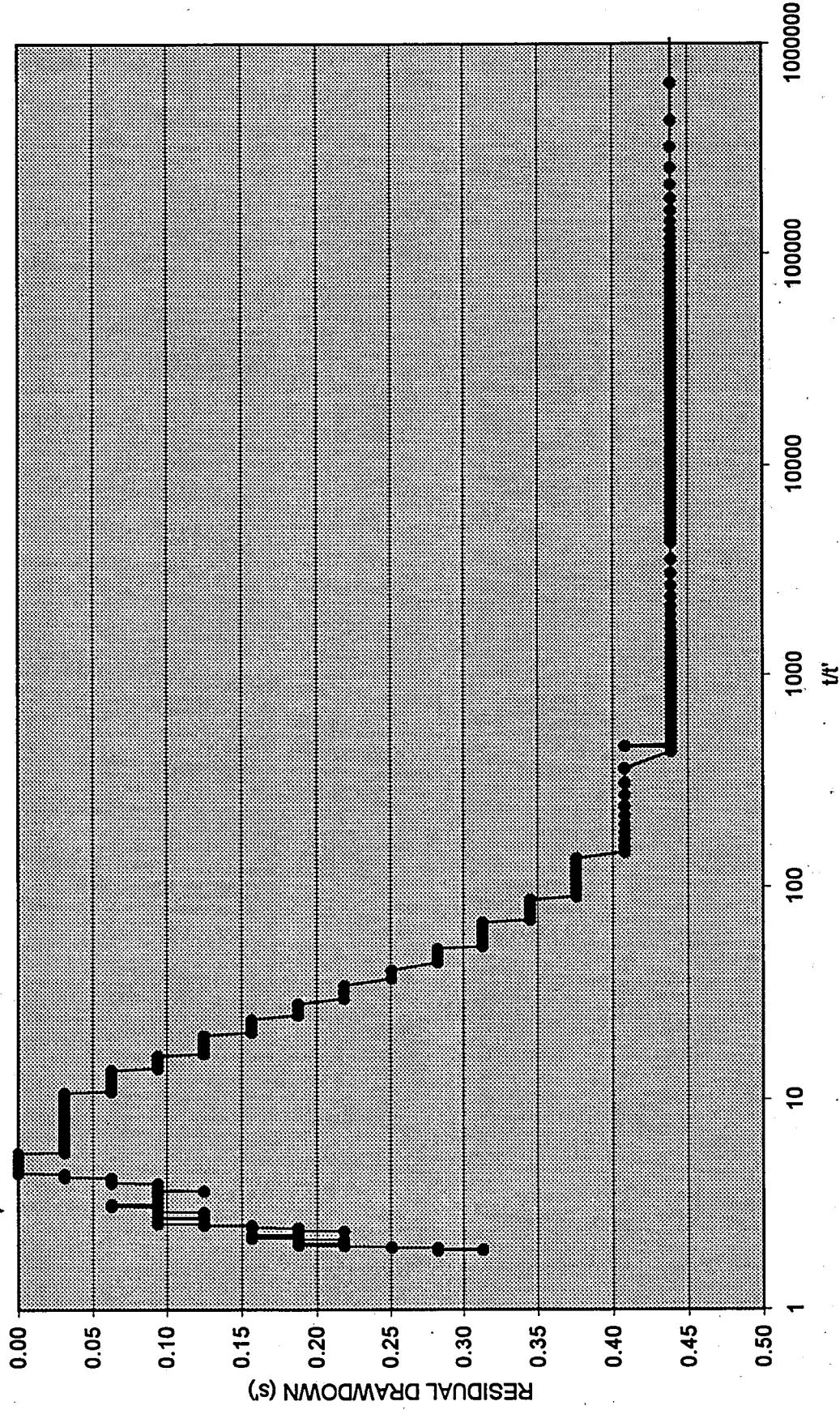
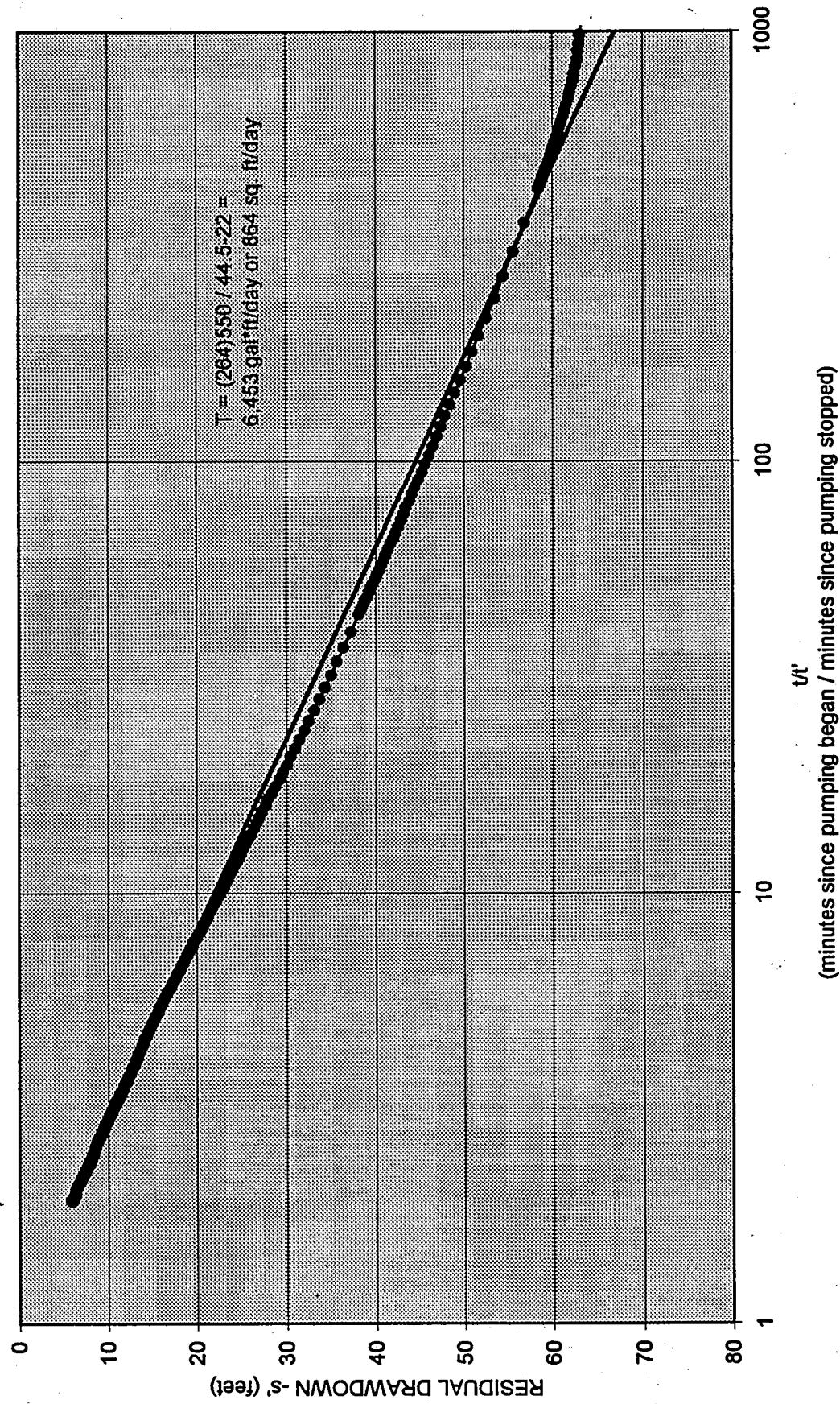


FIGURE 11. MONITORING WELL RECOVERY DATA



ARROWCREEK PRODUCTION WELL NO. 3
FIGURE 12. PUMPING WELL RECOVERY DATA



PLUMBNESS AND VIDEO SURVEYS

Plumbness (directional) and video surveys were completed on the well after the constant Q test. Data from the directional survey indicate that the well meets contract specifications. Contract specifications require the well not deviate from vertical by more than two-thirds (2/3) the well's inside diameter per 100 feet. For ArrowCreek Production Well No. 3, the well can not diverge more than 0.78 feet every 100 feet of well casing or screen, or 5.46 feet over the 700-foot well length. ArrowCreek Production Well No. 3 diverges 2.88 feet from vertical over the measurable well length of 680 feet. The contractor conducting the directional survey could not get the measuring device below the 680 feet depth because there are broken pieces of 2-inch PVC sounding tube in the bottom 20 feet of the well. Several pieces of the sounding tube broke off during installation and removal and remain in the well. No other unusual or abnormal conditions were noted when the video survey was reviewed. Appendix V includes copies of the directional survey data.

BID RESULTS

Appendix VI includes a table summarizing the bid results for the project. Six contractors submitted bids for ArrowCreek Production Well No. 3.

CONCLUSIONS AND RECOMMENDATIONS

The recommended pumping rate for ArrowCreek Production Well No. 3 is 500 gpm based on data from the aquifer tests. This pumping rate will keep the pumping level near the top of the well screen even if the well is pumped continuously for 30 days. Drawdown in the well will be approximately 133 feet and the pumping level will be approximately 465 feet below ground surface if the well is pumped at 500 gpm. A blank section was placed in the well screen between 560 and 580 feet below ground. The pump intake should be placed within the blank section.

APPENDIX I

**WHITE—DIVISION OF WATER RESOURCES
CANARY—CLIENT'S COPY
PINK—WELL DRILLER'S COPY**

NW NW 26

STATE OF NEVADA
DIVISION OF WATER RESOURCES

WELL DRILLER'S REPORT

Please complete this form in its entirety in accordance with NRS 534.170 and NAC 534.340

OFFICE USE ONLY

Log No.

Permit No.

Basin.

NOTICE OF INTENT NO. 38694

10998-A (Temp)

APPENDIX II

702-887-0627

Layne-Western Company, Inc.

A Marley Company

P.O. Box 1328, 275 County Road 88/Woodland, California 95695/Phone: 916/662-2825

(A)

Sieve Size	Cumulative Weight	% Retained	% P.A
.25 in. - 6.35 mm	0	0	10
#4 - .187 in. - 4.75 mm	0	0	10
#6 - .132 in. - 3.35 mm	0	0	10
#8 - .094 in. - 2.39 mm	1	0	10
#12 - .066 in. - 1.68 mm	10	6	95
#16 - .047 in. - 1.19 mm	50	28	72
#20 - .033 in. - .84 mm	102	57	43
#30 - .023 in. - .58 mm	148	89	17
#40 - .016 in. - .41 mm	166	93	7
#50 - .012 in. - .30 mm	170	96	4
#70 - .008 in. - .20 mm	172	97	3
#100 - .006 in. - .15 mm	174	98	2
#140 - .004 in. - .10 mm	176	99	1
Pen Weight	178	100	0

Job Name: Washoe

Date: 5/2/98

Test Hole #: Depth (ft.): 380 - 390

Dia. 50: UC = D₄₀ / D₉₀:

Comments: W6757



Layne-Western Company, Inc. A Marley Company

P.O. Box 1328, 275 County Road 88/Woodland, California 95695/Phone: 916/662-2825

(B)

Sieve Size	Cumulative Weight	% Retained	% Pas
.25 in. - 6.35 mm	0	0	10
#4 - .187 in. - 4.75 mm	0	0	10C
#6 - .132 in. - 3.35 mm	1	0	10C
#8 - .094 in. - 2.39 mm	9	7	93
#12 - .066 in. - 1.68 mm	37	29	71
#16 - .047 in. - 1.19 mm	62	48	52
#20 - .033 in. ~ .84 mm	80	63	35
#30 - .023 in. ~ .58 mm	92	72	26
#40 - .016 in. ~ .41 mm	102	80	21
#50 - .012 in. ~ .30 mm	108	84	16
#70 - .008 in. ~ .20 mm	114	89	11
#100 - .006 in. ~ .15 mm	118	92	8
#140 - .004 in. ~ .10 mm	120	94	6
Pan Weight	128	100	0

Job Name: Washoe

Date: 5/2/98

Test Hole #: _____ Depth (ft.): 480 - 490

Dia. 50: _____ UC = D_{40} / D_{90} : _____

Comments: W-6457



Layne-Western Company, Inc. A Marley Company

P.O. Box 1323, 275 County Road 56/Woodland, California 95693/Phone: 916/662-2825

(C)

Sieve Size	Cumulative Weight	% Retained	% P.
.25 in. - 6.35 mm	0	0	10
#4 - .187 in. - 4.75 mm	0	0	10
#6 - .132 in. - 3.35 mm	0	0	10
#8 - .094 in. - 2.39 mm	4	3	9
#12 - .066 in. - 1.68 mm	24	17	8
#16 - .047 in. - 1.19 mm	54	38	6
#20 - .033 in. - .84 mm	80	56	4
#30 - .023 in. - .58 mm	98	69	3
#40 - .016 in. - .41 mm	114	80	2
#50 - .012 in. - .30 mm	124	87	1
#70 - .008 in. - .20 mm	130	92	8
#100 - .006 in. - .15 mm	134	94	6
#140 - .004 in. - .10 mm	136	96	4
Pen Weight	142	100	0

Job Name: Washite

Date: 5/3/98

Test Hole #: _____ Depth (ft.): 600-610

Dia. 50: _____ UC = D_{40} / D_{90} : _____

Comments: W-6457



Layne-Western Company, Inc.

A Marley Company

P.O. Box 1328, 275 County Road 98/Woodland, California 95695/Phone: 916/822-2825

(D)

Sieve Size	Cumulative Weight	% Retained	% Pa
.25 in. - 6.35 mm	0	0	0
#4 - .187 in. - 4.75 mm	0	0	0
#6 - .132 in. - 3.35 mm	1	0	0
#8 - .094 in. - 2.39 mm	8	6	94
#12 - .066 in. - 1.68 mm	35	27	73
#16 - .047 in. - 1.19 mm	62	47	53
#20 - .033 in. - .84 mm	80	61	35
#30 - .023 in. - .58 mm	92	70	30
#40 - .016 in. - .41 mm	102	77	22
#50 - .012 in. - .30 mm	110	83	17
#70 - .008 in. - .20 mm	116	88	12
#100 - .006 in. - .15 mm	120	91	9
#140 - .004 in. - .10 mm	124	94	6
Pan Weight	132	100	

Job Name: WashoeDate: 5/2/98Test Hole #: _____ Depth (ft.): 480-490Dia. 50: _____ UC = D₄₀ / D₉₀: _____Comments: W-6457

Layne-Western Company, Inc. A Marley Company

P.O. Box 1328, 275 County Road 8B/Woodland, California 95695/Phone: 916/662-2825

(E)

Sieve Size	Cumulative Weight	% Retained	% Pw
.25 in. ~ 6.35 mm	0	0	100
#4 - .187 in. - 4.75 mm	0	0	100
#6 - .132 in. - 3.35 mm	4	2	98
#8 - .094 in. - 2.39 mm	59	35	65
#12 - .066 in. - 1.68 mm	102	61	39
#16 - .047 in. - 1.19 mm	120	72	28
#20 - .033 in. ~ .84 mm	134	80	20
#30 - .023 in. - .58 mm	144	87	13
#40 - .016 in. - .41 mm	152	92	8
#50 - .012 in. - .30 mm	156	94	6
#70 - .008 in. - .20 mm	160	96	4
#100 - .006 in. - .15 mm	162	98	2
#140 - .004 in. - .10 mm	164	99	1
Pen Weight	166		0

Job Name: Washoe

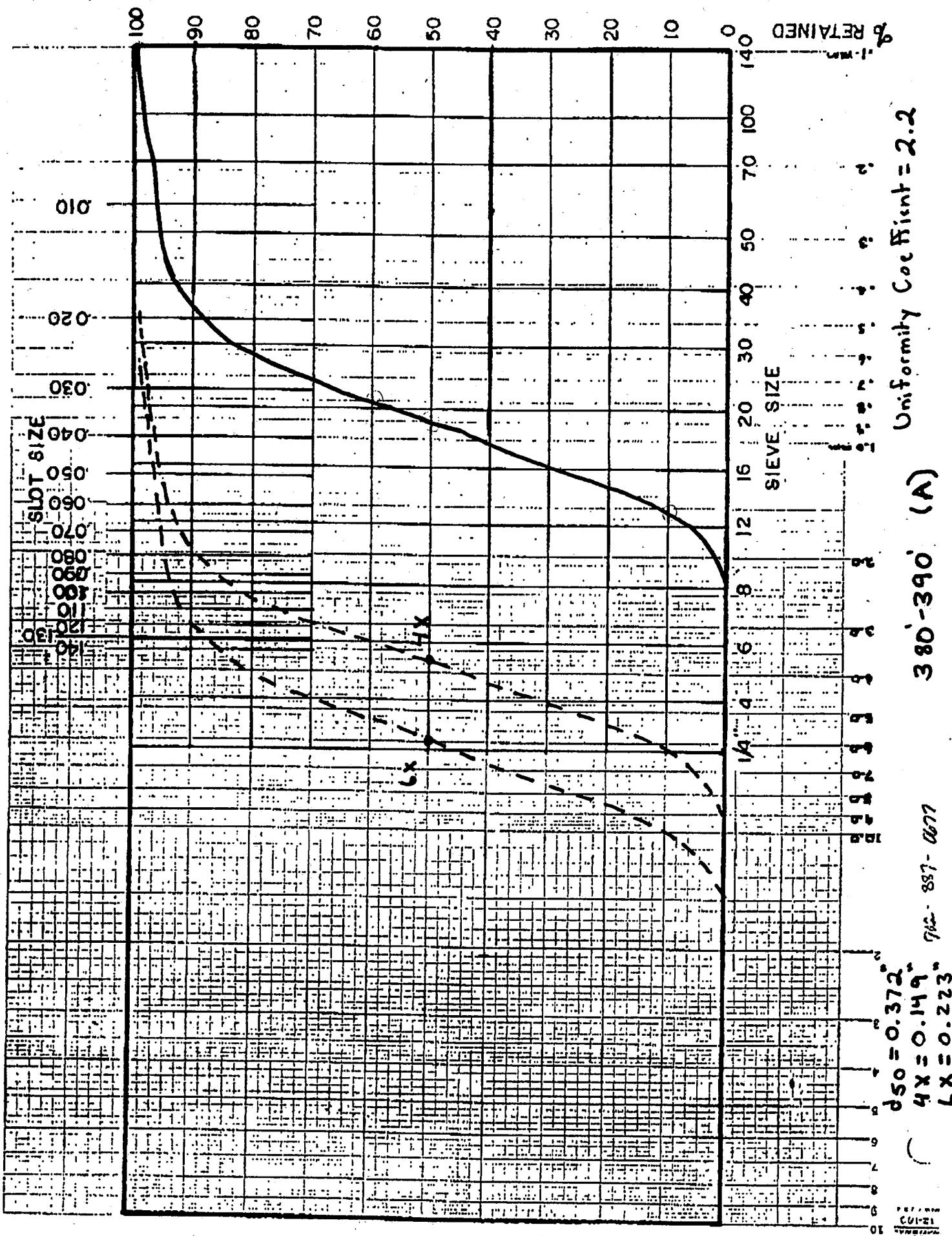
Date: 5/2/98

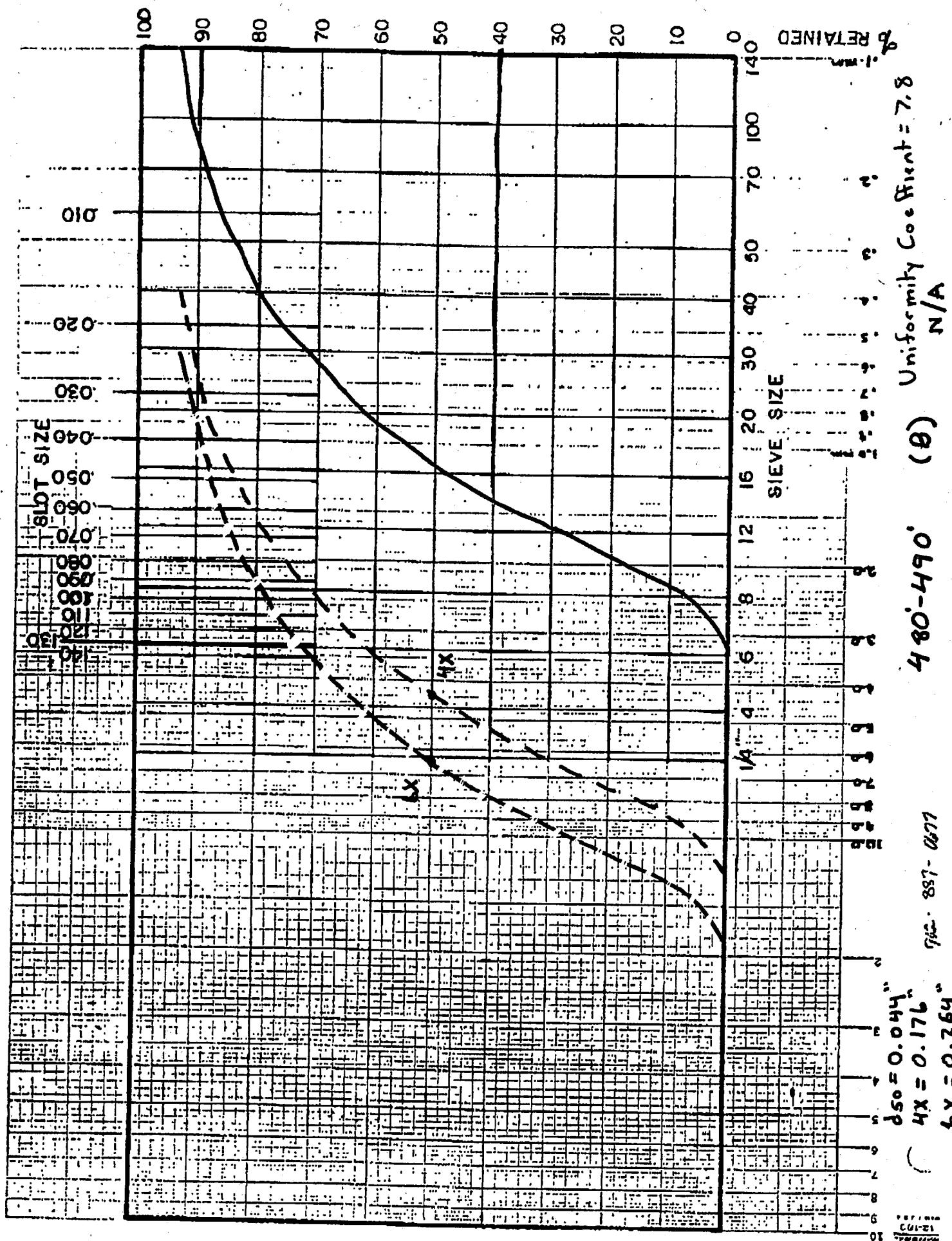
Test Hole #: _____ Depth (ft.): 440 - 450

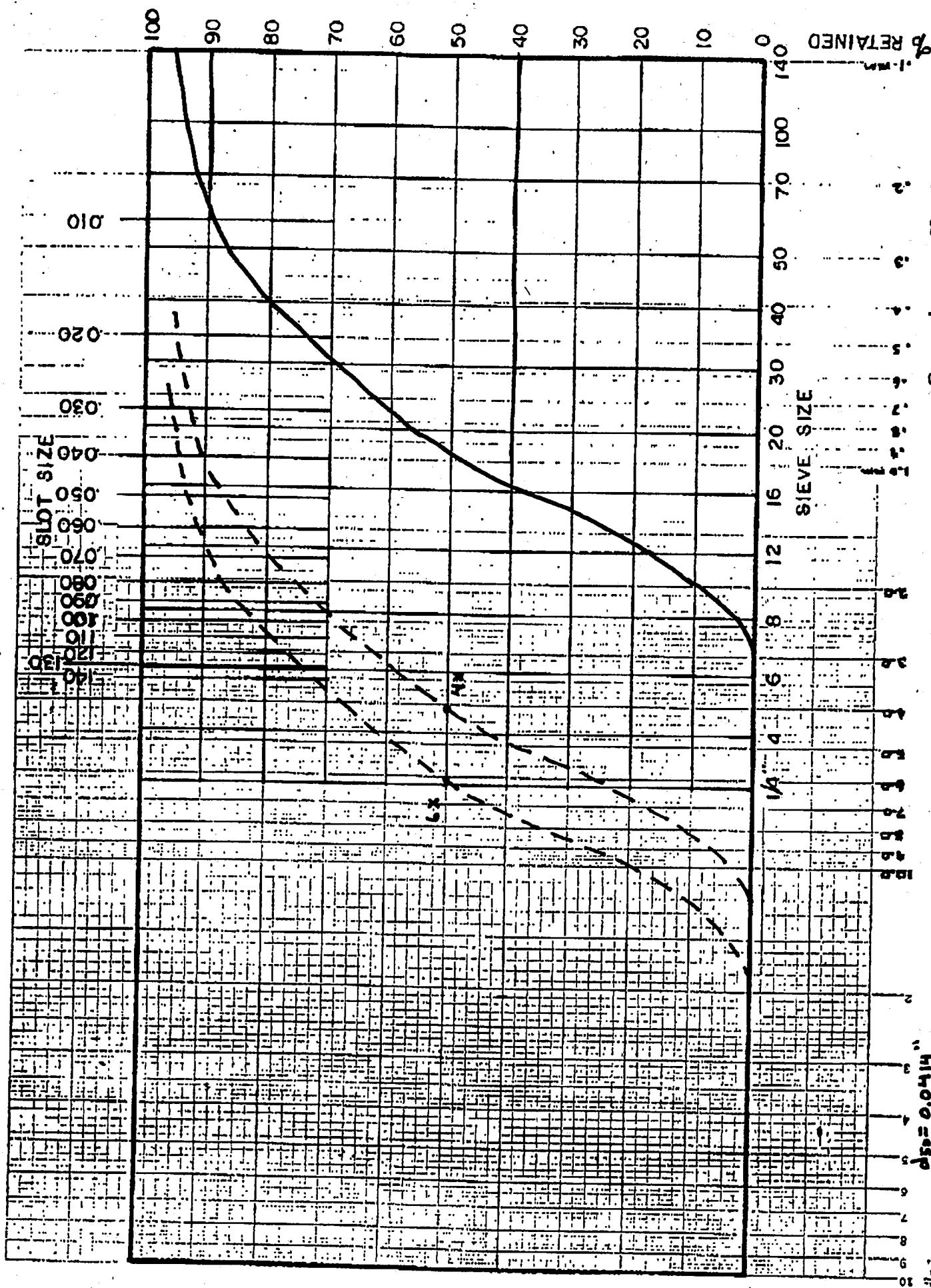
Dia. 50: _____ UC = D_{40} / D_{90} : _____

Comments: W-6457









600'-610' (c) Uniformity Coefficient = 4.75

POL - 887-0377

$$X = 0.166$$

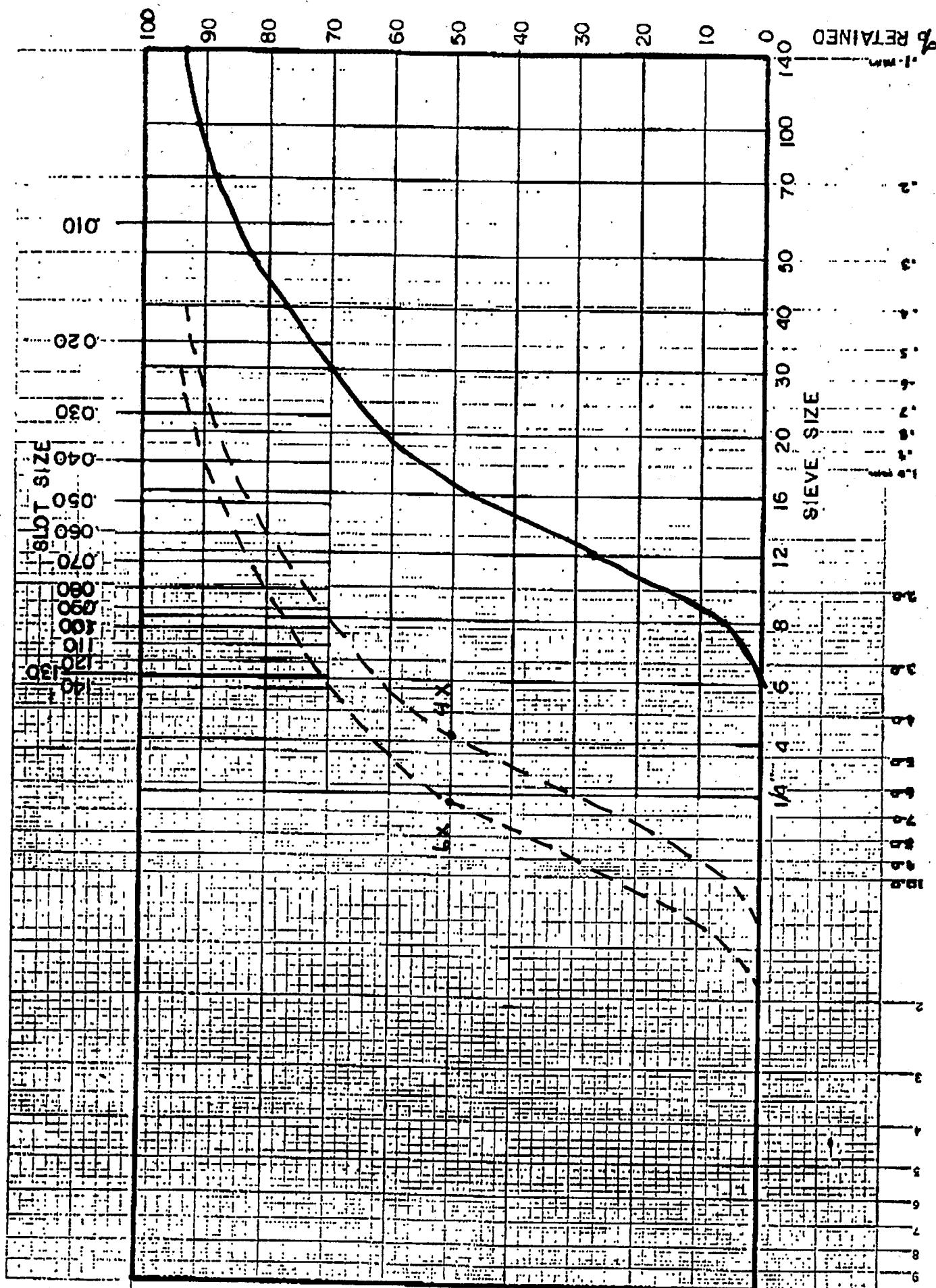
$$4X = 0.0414$$

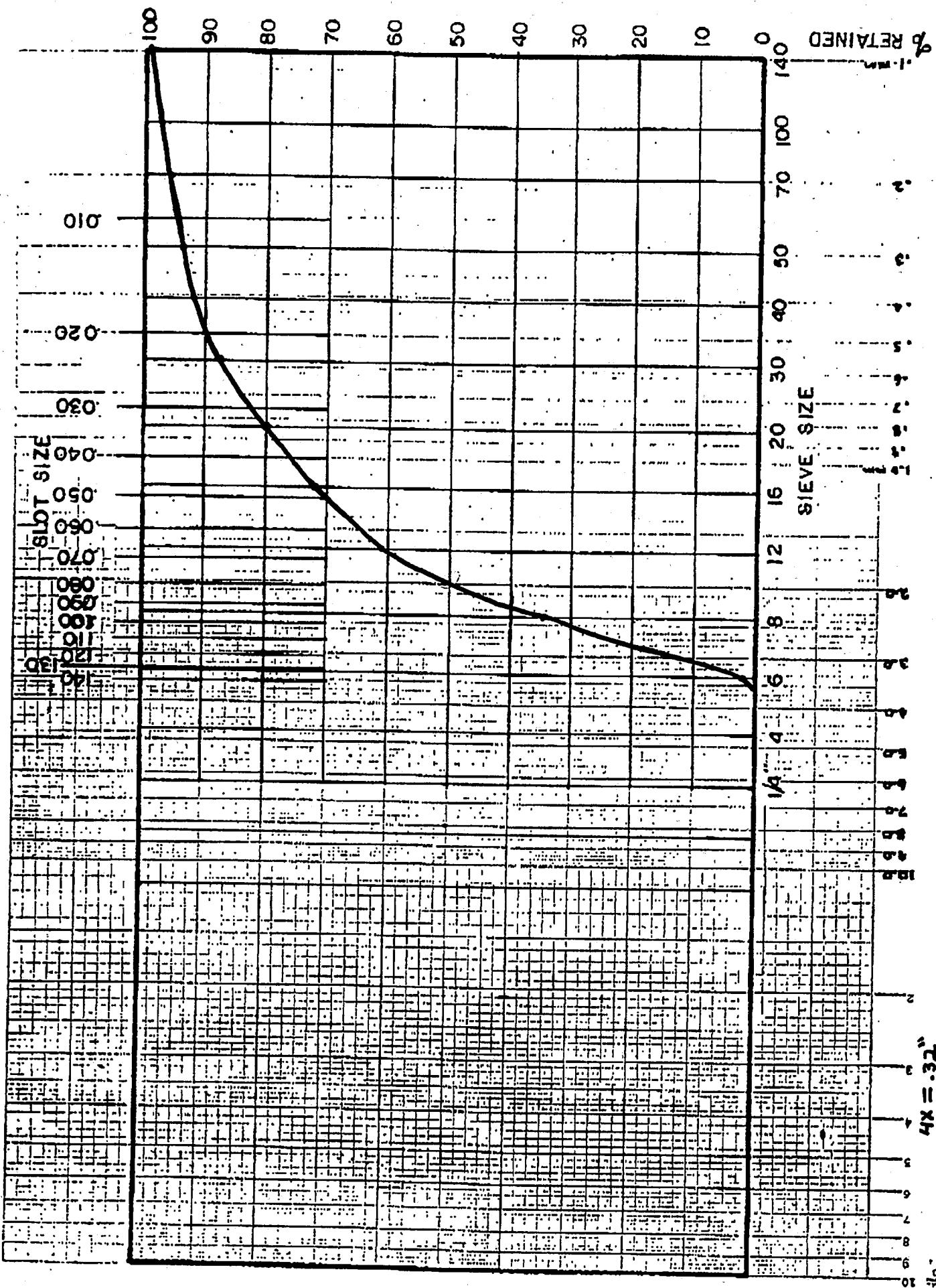
$$6X = 0.248$$

10-101

480-490 (D)

File: 887-677





440'-450' (E)

$$4x = .32"$$

$$6x = .48"$$

$$d_{50} \approx 0.08"$$

12-100
10

APPENDIX III



WASHOE COUNTY

DEPARTMENT OF PUBLIC WORKS
UTILITY DIVISION

PUMPING TEST DATA

TYPE of PUMPING TEST Step Test

HOW Q MEASURED 5x8 orifice

HOW WL's MEASURED 1000' electric Sonar

PUMPED WELL NO.

RADIUS of PUMPED WELL

DISTANCE from PUMPED WELL

WELL Armen Creek #3

PUMPING/OBSERVATION WELL

PUMPING/RECOVERY DATA

PAGE 1 OF 2

M.P. for WL's Japn F Pyc

elev.

DEPTH of PUMP/AIRLINE wrt

% SUBMERGENCE: initial _____; pumping _____

PUMP ON: date 6/14/98 time 0906

PUMP OFF: date 6/14/98 time 1540

CLOCK TIME	TIME			WATER LEVEL DATA				WATER PRODUCT.	COMMENTS
	mins	hrs	t	t/t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL		
0902		2			378.75		47.34		400 $\frac{1}{7} = 400 \text{ gpm}$
0904		4			379.59		43.18		$DD = 103.59 \text{ to scyrm c}$
0906		6			379.23		42.82		
0908		8			380.89		44.48		
0910		10			381.25		44.84		
0912		12			382.48		45.91		
0914		14			383.15		46.74		
0916		16			384.00		47.59		
0918		18			384.43		48.02		
0920		20			384.97		48.56		
0925		25			385.57		49.16		
0930		30			387.42		51.01		
		35			388.77		52.36		
		40			389.70		53.29		
		45			390.34		53.93		
		50			390.63		54.22		
		55			390.90		54.49		$Q \uparrow 1000 = 60 \text{ minutes}$
1000		60			391.29		54.88		
1000		70			393.14		56.73		There are $26\frac{1}{2}$ ft in valve. Total has about 4.
1020		80			393.53		57.12		
1030		90			393.67		57.26		
1040		100			394.59		58.18	$Q/s = 6.7$	$Q \uparrow 500 \text{ gpm } Q/100 \text{ min.}$
1045		105			405.91		69.50		
1050		110			407.34		70.93		
1055		115			408.49		72.08		
1100		120			409.20		72.79		
1110		130			410.64		74.23		
1120		140			412.11		75.70		
1130		150			412.55		76.14		
1140		160			413.22		76.81		
1150		170			414.02		77.61		
1200		180			414.66		78.25		
1210		190			414.71		78.30		
1220		200			415.70		79.29	$Q/s = 6.3$	$Q \uparrow$ increase to 600 gpm
1230		210			428.71		92.30		Took about 5 min to adj.
1240		220			430.42		94.01		$\approx 612 \text{ gpm}$
1250		230			432.44		96.03		$Q \uparrow \approx 1245$
1300		240			433.92		97.51		
1310		250			434.83		98.42		
1320		260			434.91		98.50		



WASHOE COUNTY

**DEPARTMENT OF PUBLIC WORKS
UTILITY DIVISION**

PUMPING TEST DATA

WEII Arrow Creek #3

~~PLUMMING~~ OBSERVATION WELL

PUMPING/RECOVERY DATA

PAGE 2 OF

TYPE of PUMPING TEST Step

HOW Q MEASURED $\frac{5}{8}$ " orifice

M.R. for W.L.'s top of PVC elev.

HOW WI'S MEASURED 1000' electric survey

DEPTH of PUMP/AIRLINE _____ wrt

NUMBER WELL NO. 1 (new) (first) Production Well #3

% SUBMERGENCE : initial : pumping

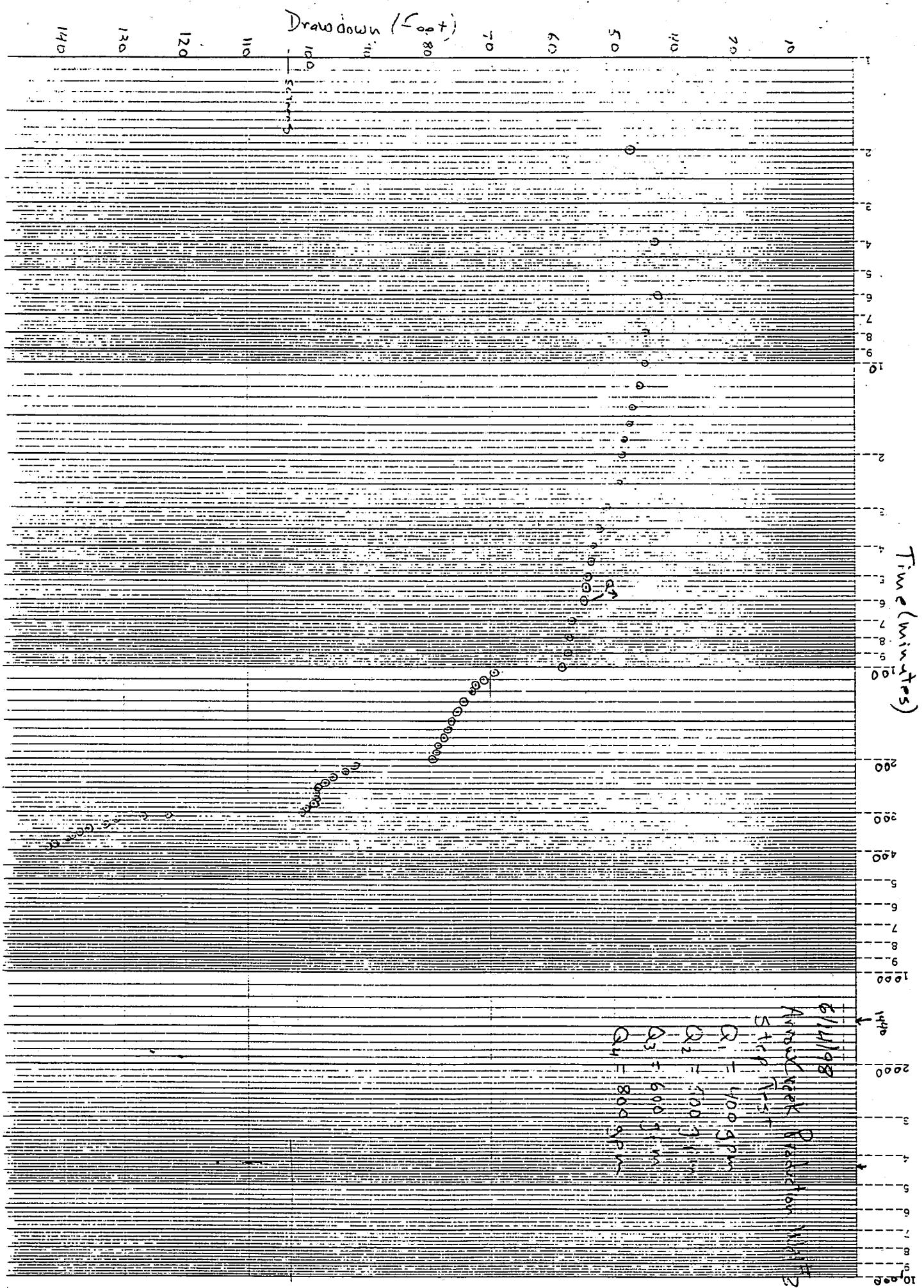
PUMPED WELL NO. 7

BUMP ON: date 6/14/98 time 0908

DISTANCE from PLUMBED WELL

PUMP OFF : date 6/14/98 time

TIME t = at t' = 0			WATER LEVEL DATA STATIC WATER LEVEL 336.41				WATER PRODUCT.		COMMENTS	
CLOCK TIME	ELAPSED TIME mins hrs	t	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	S or S'		Q	(NOTE ANY CHANGES IN OBSERVERS)	
t / t'										
1330	270		435.18		98.77				Q went from 618 to 600 during step 3.	
1340	280		436.15		99.74			Q ≈ 600 gpm		
1350	290		437.14		100.73					
1400	300		437.54		101.13		Q _s = 5.9	1Q to 800 gpm		
1405	305		459.31		122.90				took 3 min to adjust	
1410	310		463.32		126.91					
1420	320		468.04		131.63					
1430	330		469.75		133.34					
	340		472.41		136.00		Q↑			
	350		473.78		137.37					
1500	360		474.86		138.45					
	370		475.55		139.14					
	380		478.12		141.71		Q _s = 5.6	Q↑		
	390		478.87		142.46					
1540	400		480.50		144.09					





WASHOE COUNTY

DEPARTMENT OF PUBLIC WORKS
UTILITY DIVISION

PUMPING TEST DATA

WELL Amherst Fred. Well #3

PUMPING/OBSERVATION WELL
PUMPING/RECOVERY DATA
PAGE 4 OF 4

TYPE of PUMPING TEST constant

HOW Q MEASURED 5'x8" orifice

M.P. for WL's 1.90 elev. 1000'

HOW WL's MEASURED Hamit 1000

DEPTH of PUMP/AIRLINE 1000' wrt 1000'

PUMPED WELL NO. 1000

% SUBMERGENCE: initial 1.90; pumping 1.90

RADIUS of PUMPED WELL 1000'

PUMP ON: date 6/17/78 time 0945

DISTANCE from PUMPED WELL 1000'

PUMP OFF: date 6/20/78 time 0945

CLOCK TIME	TIME			WATER LEVEL DATA				WATER PRODUCT.	COMMENTS
	CLOCK TIME	ELAPSED TIME	at t=0	t/t'	READING	CONVERSIONS OF CORRECTIONS	WATER LEVEL		
		mins	hrs	t	t/t'		(333.36 331.46)		(NOTE ANY CHANGES IN OBSERVERS)
0941	10	0	1		393.35		61.89	550	sand = .2 @ 3 min
			2		392.31		50.85		.28 @ 10 min.
			3		384.29		52.83		15-25 min
			4		385.52		54.06		start 1010 = sand test
			5		387.13		55.67		30.5" = 548 gpm
			6		388.35		56.89		
			7		389.77		58.31		
			8		391.09		59.63		
			9		392.32		60.86		
0955	10	0	10		392.88		61.42		
			12		395.05		63.59		
			14		397.04		65.58		
			16		397.51		66.05		
			18		399.02		67.56		
1005	20	0	20		400.15		68.69		
			22		401.56		70.10		
			24		401.85		70.39		
			26		402.51		71.05		Q↓
			28		404.11		72.65		31" = 36 min Q = 553 gpm
1015	30	0	30		404.11		72.65		
			32		405.34		73.88		
			34		406.47		75.01		60 min. sand < 101 ml
			36		406.66		75.20		
			38		406.57		75.11		
1025	40	0	40		406.66		75.20		
			42		407.61		76.15		
			44		407.79		76.33		
			46		408.08		76.62		
			48		409.40		77.94		
			50		409.78		78.32		
			52		409.68		78.22		
			54		409.97		78.51		
			56		410.34		78.88		
			58		410.25		78.79		
			60		411.10		79.64		Q↑ @ 1057
			62		411.10		79.64		
			64		411.29		79.83		
			66		411.76		80.30		
			68		411.76		80.30		
			70		412.04		80.58		



WASHOE COUNTY

DEPARTMENT OF PUBLIC WORKS
UTILITY DIVISION

PUMPING TEST DATA

TYPE of PUMPING TEST Constant Q

HOW Q MEASURED 5" x 8" orifice

HOW WL's MEASURED Hermit 1000

PUMPED WELL NO.

RADIUS of PUMPED WELL

DISTANCE from PUMPED WELL

M.P. for WL's _____ elev. _____

DEPTH of PUMP/AIRLINE _____ wrt _____

% SUBMERGENCE: initial _____ ; pumping _____

PUMP ON: date 6/17/98 time 0945

PUMP OFF: date 6/20/98 time 0945

WELL ArrowCreek Prod.Well H-3

PUMPING/OBSERVATION WELL

PUMPING/RECOVERY DATA

PAGE 2 OF 4

CLOCK TIME	TIME		WATER LEVEL DATA				WATER PRODUCT.	(NOTE ANY CHANGES IN OBSERVERS)
	mins	hrs	t	t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	
					412.61		81.15	6.78
			72		412.51		81.05	
			74		413.55		82.09	
			76		413.93		82.47	
			78		413.84		82.38	
			80		413.74		82.28	
			82		414.12		82.66	
			84		414.12		82.66	
			86		414.12		82.66	
			88		414.50		83.04	
1115			90		414.12		82.66	
			92		414.87		83.41	
			94		415.16		83.70	
			96		415.16		83.70	
			98		415.91		84.45	
			100		416.29		84.83	
			110		416.95		85.49	
1145			120		417.99		86.53	
			130		418.74		87.28	Q↓ 1220 = 155 min.
			140		419.22		87.76	
			150		420.73		89.27	
			160		421.01		89.55	
			170		421.29		89.83	6.12
1245			180		422.43		90.97	
			190		422.80		91.34	
			200		422.90		91.44	
			210		424.12		92.66	
			220		424.41		92.95	
			230		425.63		94.17	
1345	4	-	240		425.82		94.36	
			250		425.82		94.36	
			260		426.20		94.74	Q↓ @ 1355 = 250 min.
			270		426.96		95.50	10:10 Sand = .07 @ 1400 = 230
			280		427.71		96.25	
			290		427.43		95.97	
1445	5	-	300		427.71		96.25	
1505			320		429.03		97.57	
1525			340		428.66		97.20	Q↑ 1530
1545	6	-	360		429.79		98.33	
1605	6	20	380		431.20		99.74	5.5

WASHOE COUNTY



DEPARTMENT OF PUBLIC WORKS
UTILITY DIVISION

PUMPING TEST DATA

TYPE of PUMPING TEST CONSTANT Q

HOW Q MEASURED 5" x 8" ORIFICE WEIR

M.P. for WL's _____ elev. _____

HOW WL's MEASURED HERMIT 1000

DEPTH of PUMP/AIRLINE _____ wrt _____

PUMPED WELL NO. _____

% SUBMERGENCE: initial _____; pumping _____

RADIUS of PUMPED WELL _____

PUMP ON: date 6/17/98 time 0945

DISTANCE from PUMPED WELL _____

PUMP OFF: date 6/20/98 time 0945

WELL ARROW CREEK WELL #3

PUMPING/OBSERVATION WELL

PUMPING/RECOVERY DATA

PAGE 3 OF 4

TIME $t =$ at $t' = 0$			WATER LEVEL DATA STATIC WATER LEVEL 331.46 (BGL)					WATER PRODUCT.	COMMENTS
CLOCK TIME	ELAPSED TIME mins hrs	t	READING	CONVERSIONS of CORRECTIONS	WATER LEVEL	(S) or S'	Q/S	Q	(NOTE ANY CHANGES IN OBSERVERS)
1625	6 40	400	431.96		100.50			31.5	Q↓ e 1630
1645	7 -	420	432.34		100.88				
1705	7 20	440	432.15		100.69				Q↑ e 1720
1725	7 40	460	433.00		101.54			30.5+	
1745	8 -	480	433.94		102.58				
1805	8 20	500	433.94		102.58				
1825	8 40	520	434.60		103.14			30.5	
1845	9 -	540	434.41		102.95				
1915	9 30	570	434.98		103.62				Q↑ e 1930
1945	10 -	600	435.64		104.18	5.3			Q↓ e 1945 SUN GOES DOWN
2015	10 30	630	436.02		104.56				
2045	11 -	660	437.34		105.88				
2115	11 30	690	438.19		106.73				
2145	0 12	720	438.66		107.20				Q↓ e 2155
2215	0 12	750	438.57		107.11				
2245	0 13	780	439.23		107.77				
2315	0 13	810	439.89		108.43				
2345	0 14	840	440.08		108.62				
0015	30 14	870	440.36		108.90				
0045	0 15	900	440.83		109.27				
0115	30 15	930	441.59		110.13				
0145	0 16	960	441.50		110.04				
0225	40 16	1,000	441.21		109.75				
0315	30 17	1,050	442.91		111.45				
0405	20 18	1,100	442.82		111.36				
0455	10 19	1,150	444.04		112.58				
0545	0 20	1,200	443.76		112.30				
0635	50 20	1,250	443.95		112.49				
0725	40 21	1,300	444.61		113.15	4.9			
0815	30 22	1,350	445.27		113.81				
0905	20 23	1,400	445.46		114.00				
0945	- 24	1,440	445.46		114.00				
1045	- 25	1,500	445.84		114.38				
1225	40 26	1,600	446.59		115.13				
1405	20 28	1,700	447.44		115.98				
1545	- 30	1,800	448.39		116.93				
1725	40 31	1,900	448.76		117.30				Q↓ e 1700 DD
1905	20 33	2,000	449.33		117.87				Helper adjusting Q
2045	0 35	2100	450.18		118.72				
2225	40 36	2200	450.46		119.00				MW



WASHOE COUNTY

**DEPARTMENT OF PUBLIC WORKS
UTILITY DIVISION**

PUMPING TEST DATA

WELL Arrowcreek No. 3

PUMPING/OBSERVATION WELL
PUMPING/RECOVERY DATA

TYPE of PUMPING TEST CONSTANT Q

HOW Q MEASURED 5" x 8" Orifice Weir

M.P. for WL's _____ elev.

HOW W1's MEASURED Herm. + 1000

DEPTH of PUMP/AIRLINE _____ wft

PUMPED WELL NO.

% SUBMERGENCE: initial _____; pumping

RADIUS of PUMPED WELL

PUMP ON : date 6/17/93 time 0945

DISTANCE from PUMPED WELL

PUMP OFF : date 6/20/98 time 0945

WASHOE COUNTY



DEPARTMENT OF PUBLIC WORKS
UTILITY DIVISION

PUMPING TEST DATA

WELL Arrow Creek Monitoring Well

PUMPING/OBSERVATION WELL

PUMPING/RECOVERY DATA

PAGE 1 OF 4

TYPE of PUMPING TEST _____

HOW Q MEASURED _____ M.P. for WL's TOP 2" -TRANSDUCER elev. _____

HOW WL's MEASURED _____ DEPTH of PUMP/AIRLINE _____ wrt _____

PUMPED WELL NO. _____ % SUBMERGENCE: initial _____; pumping _____

RADIUS of PUMPED WELL _____ PUMP ON: date 6/17/92 time _____

DISTANCE from PUMPED WELL _____ PUMP OFF: date _____ time _____

CLOCK TIME TIME mins. hrs	TIME at t'=0 t	t / t' t'	WATER LEVEL DATA				WATER PRODUCT.	COMMENTS (NOTE ANY CHANGES IN OBSERVERS)
			READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	S or S'		
0946	1		226.28			0		
	2		226.28			0		
	3		226.28			0		
	4		226.28			0		
	5		226.28			0		
	6		226.28			0		
	7		226.28			0		
	8		226.28			0		
	9		226.28			0		
	10		226.31			.03		
	12		226.31					
	14		226.31					
	16		226.31					
	18		226.31					
	20		226.31					
	22		226.31					
	24		226.31					
	26		226.31					
	28		226.31					
	30		226.31					
	32		226.31					
	34		226.34			.06		
	36		226.34					
	38		226.34					
	40		226.34					
	42		226.34					
	44		226.34					
	46		226.34					
	48	-	226.34					
	50		226.37			.09		
	52		226.37					
	54		226.37					
	56		226.37					
	58		226.37					
	60		226.37					
	62		226.37					
	64		226.37					
	66		226.37					
	68		226.40			.12		
	70		226.40					

WASHOE COUNTY



DEPARTMENT OF PUBLIC WORKS
UTILITY DIVISION

PUMPING TEST DATA

TYPE of PUMPING TEST Constant Q

HOW Q MEASURED 5x8 orifice

M.P. for WL's _____ elev. _____

HOW WL's MEASURED Hermit

DEPTH of PUMP/AIRLINE _____ wrt _____

PUMPED WELL NO. Arrow Creek Production Well #3

% SUBMERGENCE: initial _____ ; pumping _____

RADIUS of PUMPED WELL _____

PUMP ON: date 6/17/98 time 0945

DISTANCE from PUMPED WELL _____

PUMP OFF: date _____ time _____

WELL Arrow Creek Monitoring Well

PUMPING/OBSERVATION WELL

PUMPING/RECOVERY DATA

PAGE 2 OF 4

CLOCK TIME TIME	TIME at t' = 0		WATER LEVEL DATA STATIC WATER LEVEL 226.28 (corrected to)				WATER PRODUCT.	COMMENTS (NOTE ANY CHANGES IN OBSERVERS)
	CLOCK TIME TIME	ELAPSED TIME mins hrs	t	t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	
72					226.40		.12	
74					226.40		.12	
76					226.40		.12	
78					226.40		.12	
80					226.40		.12	
82					226.40		.12	
84					226.40		.12	
86								
88								
90	1115				226.43		.15	
92								
94								
96								
98								
100								
102	1145	0 2	120		226.46		.18	
104	1155		130					
106								
108								
110								
112								
114								
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300	1445							
302	1505							
304	1526							
306	1545							
308	1605							

WASHOE COUNTY



DEPARTMENT OF PUBLIC WORKS
UTILITY DIVISION

PUMPING TEST DATA

WELL ARROW CREEK MON WELL

PUMPING OBSERVATION WELL

PUMPING RECOVERY DATA

PAGE 3 OF 4

TYPE OF PUMPING TEST CONSTANT Q TEST

HOW Q MEASURED 5" X 8" DOWSCHE WELL

M.P. for WL's elev.

HOW WL's MEASURED HERMIT

DEPTH of PUMP/AIRLINE wrt

PUMPED WELL NO. ARROW CREEK #3

% SUBMERGENCE: initial ; pumping

RADIUS of PUMPED WELL

PUMP ON: date 6/17/98 time 0945

DISTANCE from PUMPED WELL

PUMP OFF: date time

TIME $t =$ at $t' = 0$			WATER LEVEL DATA STATIC WATER LEVEL 226.28 (BGL)				WATER PRODUCT.		COMMENTS
CLOCK TIME	ELAPSED TIME mins hrs	t	t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	(S or S')	Q	(NOTE ANY CHANGES IN OBSERVERS)
1625	6 40	400		226.59			0.31		
1645	7 -	426		"					
1705	7 20	440		"			↓		
1725	7 40	460		226.62			0.34		
1745	8 -	480		226.62					
1805	8 20	500		226.62					
1825	8 40	520		226.62					
1845	9 -	540		226.62					
1915	9 30	570		"					
1945	10 -	600		"					
2015	10 30	630		"					
2045	11 -	660		"					
2115	30 11	690		"					
2145	0 12	720		"					
2215	30 12	750		"					
2245	0 13	780		"			↓		
2315	30 13	810		226.59			0.31		
2345	0 14	840		"					
0015	30 14	870		"					
0045	0 15	900		"					
0115	30 15	930		"					
0145	0 16	960		"					
0225	40 16	1,000		"					
0315	-	1,050		"					
0405	-	1,100		"					
0455	-	1150		"					
0545	-	1200		"					
0635	-	1250		"					
0725	-	1300	-	226.62					
0815	-	1350		"					
1045	-	1500		"					
1225	-	1600		"					
1405	-	1700		226.59					
	-	2100		226.59	229.30 (sounder)				
	-	2200							
0005	-	2300							
	-	2400							
	-	2500							
	-	2600							
0645	0 45	2700		226.62					



WASHOE COUNTY

**DÉPARTEMENT OF PUBLIC WORKS
UTILITY DIVISION**

PUMPING TEST DATA

TYPE of PUMPING TEST Constant Q

HOW Q MEASURED 5" x 8" manometer

HOW WL'S MEASURED Hermit '32

PUMPED WELL NO.

RADIUS of PUMPED WELL

DISTANCE from PLUMBED WELL

WELL Arra Creek Monitoring W

~~PUMPING OBSERVATION WELL~~

PUMPING/ RECOVERY DATA

PAGE 4 OF 4

M.P. for WL's _____ elev.

DEPTH of PUMP/AIRLINE _____ wrt _____

% SUBMERGENCE: initial _____; pumping _____

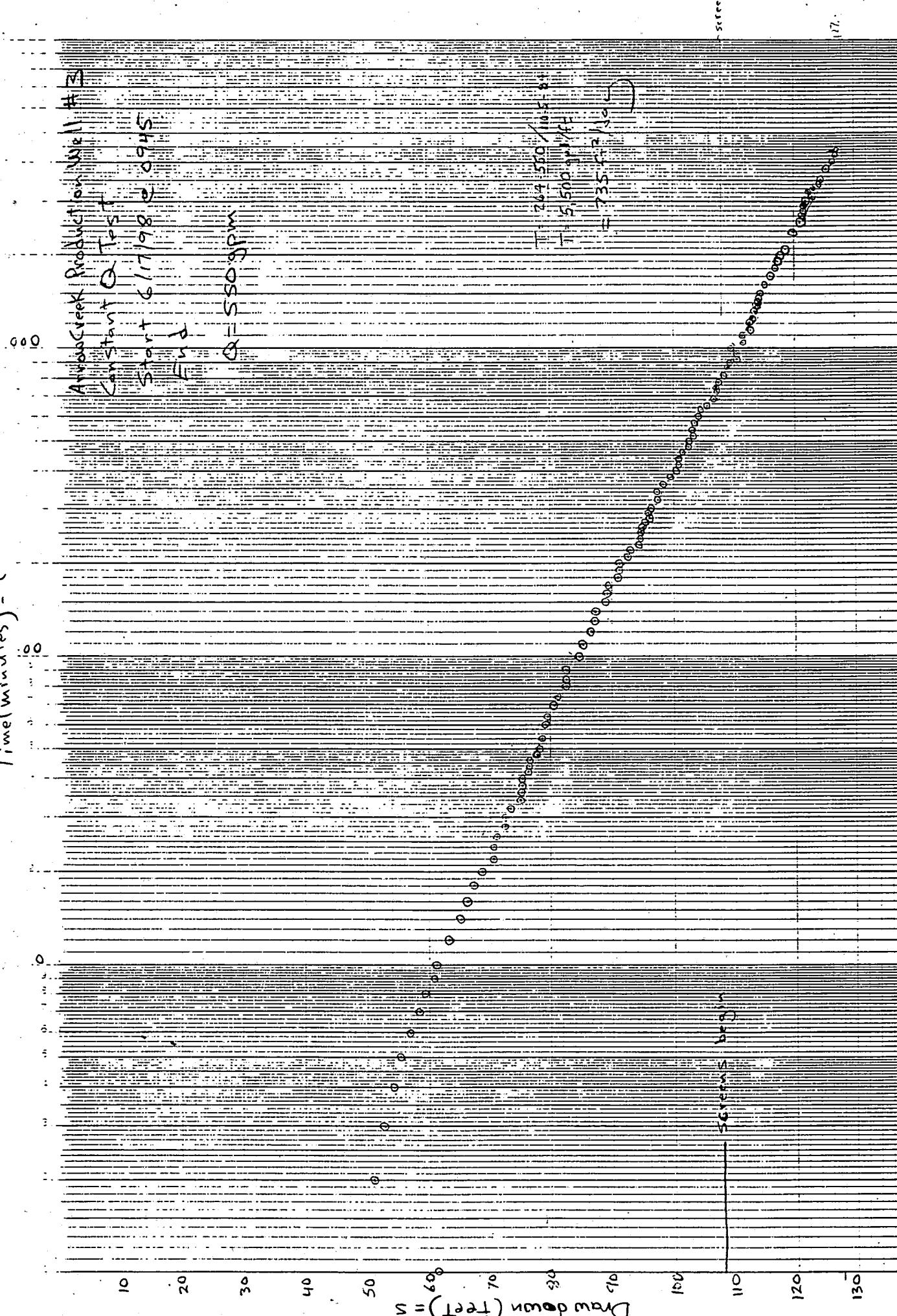
PUMP ON : date 6/17/98 time 0945

BUMPER OFF : date **time** :

Point off + date _____ time _____

POINT OF DATE _____ TIME _____

Time(minutes) = t





WASHOE COUNTY

**DEPARTMENT OF PUBLIC WORKS
UTILITY DIVISION**

PUMPING TEST DATA

WELL ArrowCreek #3
PUMPING/OBSERVATION WELL
PUMPING/RECOVERY DATA
PAGE 1 OF

TYPE of PUMPING TEST Recovery

HOW Q MEASURED

HOW WI'S MEASURED

PUMPED WELL NO. ArrowCreek #3

RADIUS of PLUMBED WELL

RADIUS OF PUMPED WELL _____
DISTANCE from PUMPED WELL _____

M.P. for WL's _____ elev. .

DEPTH of PUMP/AIRLINE _____ wrt

% SURMERGENCE : initial : BUMP

BUMP ON : date 6/17/98 Time 0945

PUMP ON : date 5/17/73 time 8:15
6/22/73 02:15

PUMP OFF : date 8/20/98 time 0943

WATER COMMUNITY

APPENDIX IV

IN TRIPPLICATE
(PLEASE PRINT OR TYPE)~~RECEIVED~~

98 JUN 19 PM 3:09

NEVADA STATE HEALTH LABORATORY
NEVADA DIVISION OF HEALTH
1660 N. Virginia Street
Reno, Nevada 89503
(702) 688-1335

138393

All of the information below must be filled in
or the analysis will not be performed.WATER CHEMISTRY ANALYSIS:
Attn: Fees may apply to some types of samples.

Appendix IV

TYPE OF ANALYSIS:
 Check here for ROUTINE DOMESTIC ANALYSIS.
 Circle the constituents needed for PARTIAL ANALYSIS.
SAMPLING INSTRUCTIONS:

The sample submitted must be representative of the source. Spring and surface water samples should be as free of dirt and debris as possible. Wells should be pumped thoroughly before sampling, changing the water in the casing at least three times. Product water from filters should be sampled after running for about ten (10) minutes.

Sampled by John Hulett Date 6-19-98
 Owner WCUD Phone _____
 Address _____
 City _____ State _____

REPORT TO:

Name Terri Svetich
 Address P.O. Box 11130
 City Reno
 State NV Zip 89520-0021

REASON FOR ANALYSIS:

- Loan
 Personal health reasons
 Purchase of the property
 Rental or sale of property
 Subdivision approval
 Other SDWA

USE OF WATER:

- Domestic drinking water
 Geothermal
 Industrial or mining
 Irrigation
 Other _____
 Initials _____

SOURCE OF WATER:

Filter Yes No
 Public Yes No
 Spring _____
 Well Depth _____ ft.
 Hot Cold
 IN USE Yes No

Type G.W.

Name _____

Surface _____

Casing diameter in.

Casing depth ft.

The results below are representative only of the sample submitted to this laboratory.

Constituent	203 ppm	0.67 Constituent	30.0 ppm	FOR LABORATORY USE ONLY		264 ppm	138393 Constituent	S.U.	PRINT OTHER DESIRED CONSTITUENTS BELOW	
				Constituent	ppm				Constituent	ppm
T.D.S. @ 30-103° C.	166	Chloride	1	Iron	0.02	Color	3		Sb	
Hardness	103	Nitrate -N	0.4	Manganese	0.00	Turbidity	0.6		Be	
Calcium	20	Alkalinity	122	Copper	0.00	pH	7.78		Cd	
Magnesium	13	Bicarbonate	149	Zinc	0.00	EC	247		Cr	
Sodium	12	Carbonate	0	Barium	0.09	SI@20C -0.34			Hg	
Potassium	5	Fluoride	0.05	Boron	0.0				Ni	
Sulfate	3	Arsenic < 0.003		Silica	64				Se	
NO ₂	<0.01	MBAS	<0.1	CN ⁻	<0.01				Tl	
				Gross					Pb	

Fee _____

Remarks PO# 167879

Collected by _____

NO PWS ID # Yet

PWS I.D. _____

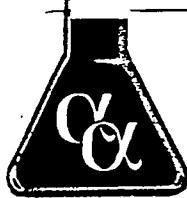
SDWA-Pri. _____

1st _____ 2nd _____ 3rd _____

ate Rec'd _____ Init. _____

ppm = parts per million, milligrams per liter

S.U. = Standard Units



Alpha Analytical, Inc.

255 Glendale Avenue, Suite 21
Sparks, Nevada 89431
(702) 355-1044
FAX: (702) 355-0406
1-800-283-1183

e-mail: alpha@powernet.net
http://www.powernet.net/~alpha

~~RECEIVED~~ LAS VEGAS, Nevada
1702) 498-3312
~~JULY 14 1998~~ SACRAMENTO, California
WASHOE COUNTY 5-366-9089
DEPT. OF WATER RESOURCES 5-366-9138

ANALYTICAL REPORT

CLIENT: Washoe County Utility Division
P.O. Box 11130
Reno, NV 89520
Attn: Randy Vanhoozer

PWS/DWR#:

Client Sample ID: Arrowcreek Well #3

Lab Sample ID: 98061919-01A

Date Sampled: 6/19/98

Date Received: 6/19/98

Matrix: DRINKING WATER

National Primary Drinking Water Phase II and Phase V - Regulated and Unregulated Synthetic Organic Compounds (SOCs)

Analyte	Result	R.L.	Units	Date Analyzed	Analyte	Result	R.L.	Units	Date Analyzed
E504.1 EDB AND DBCP					E525.2 SVOCs BY GCMS				
1,2-Dibromo-3-chloropropane	ND	0.02	µg/L	6/21/98	Alachlor	ND	0.2	µg/L	6/29/98
1,2-Dibromoethane	ND	0.01	µg/L	6/21/98	Atrazine	ND	0.1	µg/L	6/29/98
E505 ORGANOHALIDE PESTICIDES AND PCBs					Benzo(a)pyrene	ND	0.02	µg/L	6/29/98
Hexachlorocyclopentadiene	ND	0.1	µg/L	6/23/98	bis(2-Ethylhexyl)phthalate	ND	0.6	µg/L	6/29/98
Hexachlorobenzene	ND	0.1	µg/L	6/23/98	Butachlor	ND	1.0	µg/L	6/29/98
gamma-BHC	ND	0.02	µg/L	6/23/98	Metolachlor	ND	1.0	µg/L	6/29/98
Alachlor	ND	0.2	µg/L	6/23/98	Metribuzin	ND	1.0	µg/L	6/29/98
Heptachlor	ND	0.04	µg/L	6/23/98	Propachlor	ND	1.0	µg/L	6/29/98
Aldrin	ND	0.2	µg/L	6/23/98	Simazine	ND	0.07	µg/L	6/29/98
Heptachlor epoxide	ND	0.02	µg/L	6/23/98	E531.1 CARBAMATES				
Dieldrin	ND	0.2	µg/L	6/23/98	Aldicarb	ND	0.5	µg/L	6/25/98
Endrin	ND	0.01	µg/L	6/23/98	Aldicarb sulfoxide	ND	0.5	µg/L	6/25/98
Methoxychlor	ND	0.1	µg/L	6/23/98	Aldicarb sulfone	ND	0.8	µg/L	6/25/98
Chlordane	ND	0.2	µg/L	6/23/98	Carbaryl	ND	1.0	µg/L	6/25/98
Toxaphene	ND	1.0	µg/L	6/23/98	Carbofuran	ND	0.9	µg/L	6/25/98
Aroclor 1016	ND	0.08	µg/L	6/23/98	3-Hydroxycarbofuran	ND	1.0	µg/L	6/25/98
Aroclor 1221	ND	20	µg/L	6/23/98	Methomyl	ND	1.0	µg/L	6/25/98
Aroclor 1232	ND	0.5	µg/L	6/23/98	Oxamyl	ND	2.0	µg/L	6/25/98
Aroclor 1242	ND	0.3	µg/L	6/23/98	E547 GLYPHOSATE				
Aroclor 1248	ND	0.1	µg/L	6/23/98	Glyphosate	ND	6.0	µg/L	6/26/98
Aroclor 1254	ND	0.1	µg/L	6/23/98	E548.1 ENDOTHALL				
Aroclor 1260	ND	0.2	µg/L	6/23/98	Endothall	ND	9.0	µg/L	6/24/98
E515.1 CHLORINATED ACID HERBICIDES					E549.1 DIQUAT/PARAQUAT				
Dalapon	ND	1.0	µg/L	7/6/98	Diquat	ND	0.4	µg/L	6/25/98
Dicamba	ND	0.5	µg/L	7/6/98					
2,4-D	ND	0.1	µg/L	7/6/98					
PCP	ND	0.04	µg/L	7/6/98					
2,4,5-TP	ND	0.2	µg/L	7/6/98					
Dinoseb	ND	0.2	µg/L	7/6/98					
Pichloram	ND	0.1	µg/L	7/6/98					

ND = Not Detected

Approved By:

Walter Hinchman
Walter Hinchman
Quality Assurance Officer

Date: 7/8/98

Alpha Analytical, Inc.

255 Glendale Avenue, Suite 21
 Sparks, Nevada 89431
 (702) 355-1044
 FAX: (702) 355-0406
 1-800-283-1183

e-mail: alpha@powernet.net
<http://www.powernet.net/~alpha>

RECEIVED
 Nevada
 702-498-8312
 JUL 14 1998
 FAX: 503-736-7523
 Sacramento, California
 WASHOE COUNTY 866-9089
 DEPT. OF WATER RESOURCES 6-9138

ANALYTICAL REPORT

Washoe County Utility Division
 P.O. Box 11130
 Reno, NV 89520

Job#: 143874
 Phone: 954-4600
 Attn: Randy Vanhoozer

Client ID: Arrowcreek Well #3
 Lab ID: WCU98061919-01

Sampled: 06/19/98
 Received: 06/19/98

Analyzed: 06/29/98

SDWA VOLATILES PLUS LISTS 1 AND 3 UNREGULATED COMPOUNDS EPA 524.2

<u>Compound</u>	Concentration ug/L	RL ug/L	<u>Compound</u>	Concentration ug/L	RL ug/L			
1 Benzene	ND	0.50	28 Chloroform	ND	0.50			
2 Vinyl Chloride	ND	0.50	29 Chloromethane	ND	0.50			
3 Carbon tetrachloride	ND	0.50	30 o-Chlorotoluene	ND	0.50			
4 1,2-Dichloroethane	ND	0.50	31 p-Chlorotoluene	ND	0.50			
5 Trichloroethylene	ND	0.50	32 Dibromomethane	ND	0.50			
6 p-Dichlorobenzene	ND	0.50	33 m-Dichlorobenzene	ND	0.50			
7 1,1-Dichloroethylene	ND	0.50	34 1,1-Dichloroethane	ND	0.50			
8 1,1,1-Trichloroethane	ND	0.50	35 1,1-Dichloropropene	ND	0.50			
10 Regulated Volatile Organic Compounds (VOC's) (Phase II)								
9 Cis-1,2-Dichloroethylene	ND	0.50	36 1,3-Dichloropropane	ND	0.50			
10 1,2-Dichloropropane	ND	0.50	37 e,z-1,3-Dichloropropene	ND	0.50			
11 Ethylbenzene	ND	0.50	38 2,2-Dichloropropane	ND	0.50			
12 Monochlorobenzene	ND	0.50	39 1,1,2-Tetrachloroethane	ND	0.50			
13 o-Dichlorobenzene	ND	0.50	40 1,1,2,2-Tetrachloroethane	ND	0.50			
14 Styrene	ND	0.50	41 1,2,3-Trichloropropane	ND	0.50			
15 Tetrachloroethylene	ND	0.50	List 3- Monitoring Required at State Discretion					
16 Toluene	ND	0.50	42 Bromochloromethane	ND	0.50			
17 Trans-1,2-Dichloroethylene	ND	0.50	43 n-Butylbenzene	ND	0.50			
18 Xylenes (total)	ND	0.50	44 Dichlorodifluoromethane	ND	0.50			
3 Regulated Volatile Organic Compounds (VOC's) (Phase V)								
19 Dichloromethane	ND	0.50	45 Fluorotrichloroethane	ND	0.50			
20 1,1,2-Trichloroethane	ND	0.50	46 Hexachlorobutadiene	ND	0.50			
21 1,2,4-Trichlorobenzene	ND	0.50	47 Isopropylbenzene	ND	0.50			
List 1 - Unregulated Compounds - All Systems								
22 Bromobenzene	ND	0.50	48 p-Isopropyltoluene	ND	0.50			
23 Bromodichloromethane	ND	0.50	49 Naphthalene	ND	0.50			
24 Bromoform	ND	0.50	50 n-Propylbenzene	ND	0.50			
25 Bromomethane	ND	0.50	51 sec-Butylbenzene	ND	0.50			
26 Chlorodibromomethane	ND	0.50	52 tert-Butylbenzene	ND	0.50			
27 Chloroethane	ND	0.50	53 1,2,3-Trichlorobenzene	ND	0.50			
			54 1,2,4-Trimethylbenzene	ND	0.50			
			55 1,3,5-Trimethylbenzene	ND	0.50			
			ND-Not Detected					
			RL-Reporting Limit					

Approved by:

Roger L. Scholl, Ph.D.
 Laboratory Director

Date:

7/6/98

APPENDIX V

>>> Welenco, Inc. >>>

DIRECTIONAL SURVEY

Date: JUNE 30, 1998

Company : LAYNE CHRISTENSEN DRILLING
Well No : ARROW CREEK #3
Field : THOMAS CREEK, RENO
State : NEVADA County: WASHOE
Witnessed By : Rec. By: ROBERTI
Location : MT. ROSE HWY AND THOMAS CREEK RD.
Remarks :

OTHER SERVICES: SIDE SCAN VIDEO

Measured Depth, Feet	Incli- nation, Degrees	Dirrec- tion, Degrees	Course, True	True Deviation, Vertical	Closure Distance, Feet	Closure Bearing, Degrees
0	0.0	0	0.00	0.00	0.00	0.0
50	0.5	115	0.21	50.00	0.21	115.0
100	0.0	130	0.21	100.00	0.41	115.2
150	0.3	118	0.15	150.00	0.57	116.0
200	0.4	96	0.34	200.00	0.90	112.1
250	0.6	133	0.45	249.99	1.32	113.7
300	0.4	172	0.41	299.99	1.66	121.4
350	0.4	165	0.34	349.99	1.91	128.9
400	0.2	91	0.27	399.99	2.12	130.2
450	0.3	61	0.21	449.99	2.24	126.0
500	0.3	39	0.24	499.99	2.31	120.4
550	0.4	73	0.29	549.99	2.45	114.7
600	0.5	23	0.37	599.99	2.58	107.8
650	0.2	102	0.30	649.99	2.71	103.4
680	0.4	114	0.18	679.99	2.88	103.8

Equip.: L-17

Office: BFL

Job No.: 29344

Calculation Method: Balanced Tangential

Company: LAYNE CHRISTENSEN DRILLING

Well #: 1

ARROW CREEK #3

Date: JUNE 30, 1998

PLANE OF ROTATED

CLOSURE 0 90 DEGREES

70

140

210

280

350

420

490

560

630

700

VERTICAL SECTION

Vert Scale = 70 Ft/Div

Horz Scale = 7 Ft/Div

CLOSURE

Distance: 2.88 FEET

Bearing: 103.8 DEGREES

T.U.D.: 679.99 FEET

Calc. Method:
Horizontal Transit

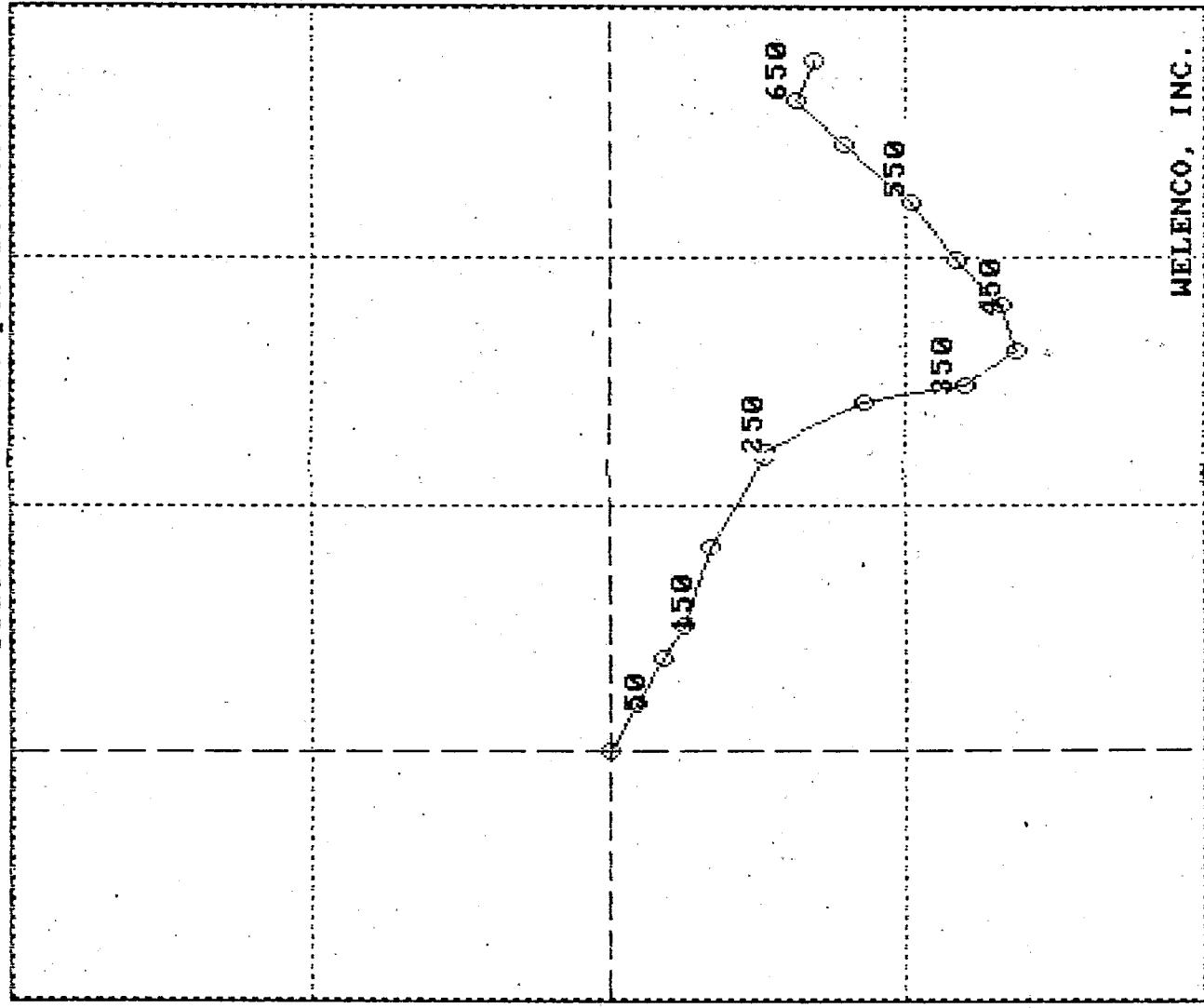
Company: LAYNE CHRISTENSEN DRILLING

PLAN VIEW

Well #: ARROW CREEK #3

Date: JUNE 30, 1998

Scale = 1 Feet per Division



CLOSURE

Distance: 2.88 FEET

Bearing: 103.8 DEGREES

T.U.D.: 679.99 FEET

$$\frac{2.88}{679.99} \approx .00424 \\ .4\%$$

Calc. Method
Balanced Tangential

WILENCO, INC.

APPENDIX VI

ARROWCREEK PRODUCTION WELL NO. 3
BID RESULTS
FEBRUARY 5, 1998

ITEM DESCRIPTION	QUANT.	UNIT	LAYNE CHRISTENSEN			SARGENT IRRIGATION			LANG EXPLORATORY DRILLING		
			UNIT PRICE	TOTAL	UNIT PRICE	TOTAL	UNIT PRICE	TOTAL	UNIT PRICE	TOTAL	UNIT PRICE
1 Mobilization and Demobilization	1	L.S.	\$14,000.00	\$14,000.00	\$23,000.00	\$23,000.00	\$16,000.00	\$16,000.00	\$16,000.00	\$16,000.00	\$16,000.00
2 Standby Hours	24	Hr.	\$185.00	\$4,440.00	\$130.00	\$3,120.00	\$110.00	\$2,640.00	\$160.00	\$2,640.00	\$160.00
3 Drill 26" Borehole	100	L.F.	\$166.00	\$16,600.00	\$100.00	\$10,000.00	\$64.00	\$6,464.00	\$64.00	\$6,464.00	\$64.00
4 Install 22" Conductor Casing	101	L.F.	\$62.00	\$6,262.00	\$70.00	\$7,070.00	\$4,000.00	\$4,000.00	\$4,000.00	\$4,000.00	\$4,000.00
5 Install 100' Sanitary Seal	1	L.S.	\$3,400.00	\$3,400.00	\$3,000.00	\$3,000.00	\$33,000.00	\$33,000.00	\$82.00	\$49,200.00	\$82.00
6 Drill 20" Borehole	600	L.F.	\$80.00	\$48,000.00	\$55.00	\$33,000.00	\$11,040.00	\$32.00	\$14,720.00	\$11,040.00	\$14,720.00
7 Install 14" Well Casing	460	L.F.	\$30.00	\$13,800.00	\$24.00	\$12,000.00	\$58.00	\$13,920.00	\$58.00	\$13,920.00	\$58.00
8 Install 14" Well Screen	240	L.F.	\$39.00	\$9,360.00	\$50.00	\$25.00	\$378.00	\$9,450.00	\$25.00	\$378.00	\$25.00
9 Install Gravel Pack	25	Cu.Yd.	\$85.00	\$2,125.00	\$250.00	\$6,250.00	\$275.00	\$11,000.00	\$275.00	\$11,000.00	\$275.00
10 Air Lift Development	40	Hr.	\$140.00	\$5,600.00	\$220.00	\$8,800.00	\$16.00	\$7,200.00	\$16.00	\$7,200.00	\$16.00
11 Install Pumping Test Equipment	450	L.F.	\$10.00	\$4,500.00	\$20.00	\$9,000.00	\$180.00	\$4,320.00	\$180.00	\$4,320.00	\$180.00
12 Pumping Development	24	Hr.	\$105.00	\$2,520.00	\$130.00	\$3,120.00	\$160.00	\$12,800.00	\$160.00	\$12,800.00	\$160.00
13 Operate Pumping Test	80	Hr.	\$105.00	\$8,400.00	\$130.00	\$10,400.00	\$1,150.00	\$1,150.00	\$1,150.00	\$1,150.00	\$1,150.00
14 Video Survey	1	L.S.	\$1,200.00	\$1,200.00	\$2,600.00	\$2,600.00	\$1,850.00	\$1,850.00	\$1,850.00	\$1,850.00	\$1,850.00
15 Gyroscopic Deviation Survey	1	L.S.	\$1,200.00	\$1,200.00	\$2,200.00	\$2,200.00	\$500.00	\$500.00	\$500.00	\$500.00	\$500.00
16 Well Disinfection, Capping, etc.	1	L.S.	\$1,000.00	\$1,000.00	\$1,000.00	\$1,000.00	\$145,600.00	\$145,600.00	\$171,214.00	\$171,214.00	\$171,214.00
		TOTAL									

ARROWCREEK PRODUCTION WELL NO. 3
 BID RESULTS
 FEBRUARY 5, 1998

ITEM DESCRIPTION	QUANT.	UNIT	HUMBOLT DRILLING		BEYLIK DRILLING	
			UNIT PRICE	TOTAL	UNIT PRICE	TOTAL
1 Mobilization and Demobilization	1	L.S.	\$25,000.00	\$25,000.00	\$71,612.00	\$71,612.00
2 Standby Hours	24	Hr.	\$150.00	\$3,600.00	\$200.00	\$4,800.00
3 Drill 26" Borehole	100	L.F.	\$255.00	\$25,500.00	\$185.00	\$18,500.00
4 Install 22" Conductor Casing	101	L.F.	\$38.28	\$3,866.28	\$50.00	\$5,050.00
5 Install Sanitary Seal	1	L.S.	\$1,800.00	\$1,800.00	\$5,000.00	\$5,000.00
6 Drill 20" Borehole	600	L.F.	\$138.00	\$82,800.00	\$97.00	\$58,200.00
7 Install 14" Well Casing	460	L.F.	\$18.66	\$8,583.60	\$38.00	\$17,480.00
8 Install 14" Well Screen	24.0	L.F.	\$36.87	\$8,848.80	\$56.00	\$13,440.00
9 Install Gravel Pack	25	Cu.Yd.	\$150.00	\$3,750.00	\$225.00	\$5,625.00
10 Air lift Development	40	Hr.	\$200.00	\$8,000.00	\$250.00	\$10,000.00
11 Install Pumping Test Equipment	450	L.F.	\$14.00	\$6,300.00	\$25.00	\$1,250.00
12 Pumping Development	24	Hr.	\$150.00	\$3,600.00	\$150.00	\$3,600.00
13 Operate Pumping Test	80	Hr.	\$150.00	\$12,000.00	\$150.00	\$12,000.00
14 Video Survey	1	L.S.	\$1,000.00	\$1,000.00	\$1,000.00	\$1,000.00
15 Gyroscopic Deviation Survey	1	L.S.	\$3,000.00	\$3,000.00	\$3,000.00	\$3,000.00
16 Well Disinfection, Capping, etc.	1	L.S.	\$1,000.00	\$1,000.00	\$1,500.00	\$1,500.00
TOTAL				\$198,648.68		\$242,057.00