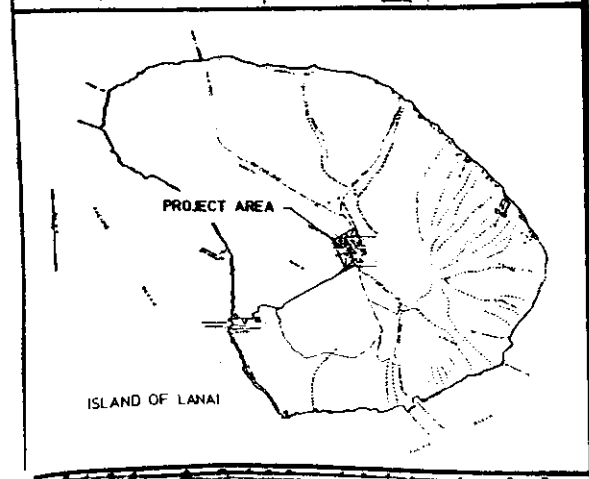


LANAI 8

(Well No. 4954-02)



ISLAND OF LANAI

PROJECT AREA

# LANAI WELL # 8 4954-02

APRIL 23, 1990

## DATA REPORTED BY DRILLER:

TOTAL DEPTH: 1489'

ROTARY TABLE: 9' ABOVE GR.

EL. CONCL. PAD: 1902'

## LOGGER DATA:

WATER LEVEL: OBS. DTW = 589.1' (REF GR)

CORR. DTW = 590.2' OR  
1311.8' MSL

TEMP. PROBE: GR. LEVEL INSIDE CONDUCTOR

PIPE: 72.4° F.

AT. 1484': 76.8° F.

NOTE: BECAUSE THE DRILL RIG WAS STILL OVER WELL #8, LOGGING LINE HAD TO BE SUSPENDED FROM A SHEAVE APPROX. 8 FT. ABOVE ROTARY TABLE. THIS SETUP RESULTED IN A LOSS OF SENSITIVITY IN THE LOGGER LINE'S WEIGHT INDICATOR AND THOUGH WE CHECKED THE WEIGHT OF THE LINE MANUALLY, TWO SITUATIONS MAY HAVE OCCURRED. 1) LINE COULD HAVE HUNG UP AT DIFFERENT POINTS. 2) LINE MAY HAVE BEEN DRAGGING IF HOLE IS OUT OF ALIGNMENT. BOTH COULD RESULT IN FALSE READINGS.

LANDRI WELL #C 4954-02

NOTE CONT:

DURING TEMPERATURE LOGGING I COULD NOT DETECT AT WHAT POINT THE PROBE HIT WATER. THIS MAY HAVE BEEN A RESULT OF MUD (BENTONITE) COVERING AND INSULATING THE TEMP. SENSOR. WE DID NOTICE A LOT OF MUD AND WELL IS UNCASSED.

MITCHELL K. DAYE

# GROUND WATER DATA CODING SCHEDULE

U.S. Geological Survey and Hawaii Department of Land & Natural Resources Honolulu, Hawaii

DOWLED Form 75-A

## REFERENCE

1	2	9	25	29
ISL	WELL NO.	NAME OR LOCATION	YR. DRILLED	DRILLER

- |            |             |           |               |
|------------|-------------|-----------|---------------|
| 1 - Niihau | 3 - Oahu    | 5 - Lanai | 7 - Kahoolawe |
| 2 - Kauai  | 4 - Molokai | 6 - Maui  | 8 - Hawaii    |

42	44	50	57	80
QUAD MAP	LATITUDE	LONGITUDE	OWNER OR USER	OLD WELL NO.

## PHYSICAL DATA

1	9	12	15	19	23	27	31	34
same as card 1	TYPE OF CONST.	CSG. DIA. (in.)	GROUND ELEV. (feet)	TOTAL DEPTH (feet)	BOT. OF SOLID CSG. (feet)	BOT. OF PERF. CSG. (feet)	MAJOR USE	YEAR

rotary  
percussion  
tunnel  
dug

municipal  
irrigation  
industrial  
domestic  
unused  
sealed

observation  
disposal  
lost  
recharge  
other

36	41	46	50	54	59	63
WATER LEVEL (feet)	CHLORIDES (mg/l)	RATE (gpm)	DRAWDOWN (feet)	CHLORIDES (mg/l)	TEMP. °F	TEMP. °C

INITIAL TEST                      PUMPING TEST (Values at highest sustained rate)

64	67	70	73	76
CHLOR. ANAL.	WATER LEVEL	WATER TEMP.	CHEM. ANAL.	DRAFT

annually  
monthly  
weekly

daily  
recorder  
occasional

FREQ. OF RECORDS AVAILABLE USGS

## WATER SUPPLY

1	9	14	19	23	27	31
same as card 1	PUMP CAPACITY (gpm)	ANNUAL DRAFT (mgy)	STATIC HEAD (feet)	MAX. CHLORIDES (mg/l)	MIN. CHLORIDES (mg/l)	AQUIFER

35
YEAR

37
YEAR

39
YEAR

41
YEAR

43
YEAR

PERSON FILING SCHEDULE

/n

DATE

10/90

-
---

well no.

CARD 1

CARD 2

CARD 3

1

  
CARD NO.

2

  
CARD NO.

3

  
CARD NO.

DEPARTMENT OF LAND & NATURAL RESOURCES  
DIVISION OF WATER AND LAND DEVELOPMENT  
DRILLER'S REPORT

COUNTY

DESCRIPTION

Date of report August 21, 1990 Person filing report Blaise Clay  
A. OWNER Lanai Company Inc. WELL NAME Lanai Well #8 ISLAND Lanai  
B. GENERAL LOCATION One-half mile northeast of Lanai City  
C. DRILLING COMPANY Water Resources Int'l. Inc.  
D. TYPE OF RIG Rotary DRILLING COMPLETED 04/90 DRILLER Underwood/Harmon  
E. ELEVATION, msl: Top of drilling platform 1870+ ft. Bench mark and method used to determine  
Height of drilling platform above ground surface 10 ft. elevation: 1870+ ft.  
F. HOLE SIZE: 17 1/2 inch dia. to 1500 ft. below drilling platform.  
14 inch dia. to ft. below drilling platform.  
14 inch dia. to ft. below drilling platform.  
G. CASING INSTALLED: 14 in. I.D. x 5/16 in. wall solid section to 952 ft. below drilling platform.  
14 in. I.D. x 5/16 in. wall perforated section to 1495 ft. below drilling platform.  
Type of perforation Ful-Flo  
H. ANNULUS: Grouted 10 ft to 210 ft. below drilling platform.  
Gravel packed 210 ft. to 1500 ft. below drilling platform.  
I. PERMANENT PUMP INSTALLATION:  
Pump type, make, serial no. Capacity g.p.m.  
Motor type, H.P., voltage, r.p.m.  
Depth of pump intake setting ft. below which elevation is ft.  
Depth of bottom of airline ft. below which elevation is ft.

HYDROLOGY

J. INITIAL WATER LEVEL 888 ft. below drilling platform. Date of measurement 5/10/90  
K. INITIAL CHLORIDE: ppm, total depth of well ft. below drilling platform  
(see attached) Sampling Date  
L. PUMPING TESTS: Reference point (R.P.) used: which elevation is ft.  
Date Date  
Start water level ft. below R. P. Start water level ft. below R. P.  
End water level ft. below R. P. End water level ft. below R. P.  
Depth of well ft. below R. P. Depth of well ft. below R. P.  
Elapsed Rate Draw-down CI- Temp. Elapsed Rate Draw-down CI- Temp.  
Time (hours) (gpm) (ft.) (ppm) F Time (hours) (gpm) (ft.) (ppm) F  
to Unavailable to  
to Please obtain from Owner to  
to to  
to to  
to to

SUBSURFACE FORMATION

M. DRILLER'S LOG:

Depth, ft.	Rock Description & Remarks	Water Level ft.	Depth, ft.	Rock Description & Remarks	Water Level ft.
0 to 40	Clay/decomposed lava		780 to 980	Broken aa, clinkery	
40 to 80	Broken aa & cinders		980 to 1140	Clinkery, broken lava rock	
80 to 120	Med. lava rock		1140 to 1220	Med. hard lava rock	
120 to 200	Clinkery		1220 to 1400	Hard dense blue lava rock	
200 to 340	Cinders & broken aa		1400 to 1490	Med. hard dense rock	
340 to 380	Med. hard blue lava rock				
380 to 420	Hard pahoehoe				
420 to 520	Red cinders				
520 to 550	Decomposed lava rock				
550 to 580	Med. hard rock				
580 to 780	Hard lava rock				

N. REMARKS:

FOR DRILLER'S USE

INSTRUCTIONS: Send three(3) copies to: Manager-Chief Engineer, Division of Water and Land Development, P. O. Box 373, Honolulu, Hawaii 96809.

FOR OFFICIAL USE

Latitude

REFERENCES: Chapter 178, entitled "Artesian Wells, Generally," HRS, as amended by Act 123 SLH 1970. Honolulu Board of Water Supply, "Rules and

Longitude

Job Name



970 N. Kalaheo Avenue, Suite A300 • Kailua, Hawaii 96734

Telephone: (808) 254-5884

JOB NO.: 457

DATE: 03/29/90

PAGE: 1 of 3

TO: M &amp; E Pacific

ATTN: Jim Dexter

SAMPLE SITE: Lanai Well #8

RECEIPT DATE: 02/27/90

DATE SAMPLED: 02/26/90

TIME SAMPLED: 14:35-15:30

LOG #: 4045

SAMPLED BY: James Dexter

## LABORATORY ANALYSIS REPORT - Primary Drinking Water Standards

	Amount Detected	Detection Limit	Date Analyst
Arsenic (mg/l)	BDL	0.002	03/07 BAL
Barium (mg/l)	BDL	0.1	03/07 BAL
Cadmium (mg/l)	BDL	0.005	03/07 BAL
Chromium (mg/l)	0.02	0.02	03/07 BAL
Lead (mg/l)	BDL	0.02	03/07 BAL
Mercury (mg/l)	BDL	0.0002	03/07 BAL
Selenium (mg/l)	BDL	0.002	03/07 BAL
Silver (mg/l)	BDL	0.01	03/07 BAL
Fluoride (mg/l)	BDL	0.1	03/02 er
Nitrate (mg/l)	0.57	0.03	03/07 BAL
Turbidity (NTU)	47	0.1	02/27 mm
Total Coliform (col/100 mls)	Sample spilled in transit	1	----
Gross Alpha (pCi/l)	----	2	----
Gross Beta (pCi/l)	----	3	----
Endrin (mg/l)	BDL	0.0002	03/13 km/mm
Lindane (mg/l)	BDL	0.0001	03/13 km/mm
Methoxychlor (mg/l)	BDL	0.0005	03/13 km/mm
Toxaphene (mg/l)	BDL	0.005	03/13 km/mm
2,4-D (mg/l)	BDL	0.002	03/07 km/mm
2,4,5-TP (mg/l)	BDL	0.001	03/07 km/mm

BDL = Below Detection Limit

Samples analyzed according to "Methods for Chemical Analysis of Water and Wastes", U.S. EPA, March, 1979 and/or "Methods for Organochlorine Pesticides and Chlorophenoxy Acid Herbicides in Drinking Water and Raw Source Water", U.S. EPA, July, 1978.

JOB NO.: 457  
 LOG #: 4045  
 DATE: 3/29/90  
 PAGE: 2 of 3

### Secondary Drinking Water Standards

	Amount Detected	Detection Limit	Date Analyst
Alkalinity (mg CaCO <sub>3</sub> /l)	----	5	----
Calcium Hardness (mg CaCO <sub>3</sub> /l)	----	0.5	----
Chloride (mg/l)	40	5	02/28 er
Color (APCU)	----	10	----
Copper (mg/l)	----	0.01	----
Total Dissolved Solids (mg/l)	236	10	03/29 mm
Corrosivity (Langelier Index)	----	----	----
Foaming Agents (mg LAS/l)	----	0.025	----
Iron (mg/l)	----	0.02	----
Manganese (mg/l)	----	0.01	----
pH	7.74	0.1	02/27 mm
Sulfate (mg/l)	----	2	----
Zinc (mg/l)	----	0.005	----
Silica (mg/l)	39	----	03/07 BAL
Magnesium (mg/l)	15.7	----	03/07 BAL
Calcium (mg/l)	15.6	----	03/07 BAL

BDL = Below Detection Limit

Samples analyzed according to "Methods for Chemical Analysis of Water and Wastes", U.S. EPA, March 1979.

JOB NO.: 457  
LOG #: 4045  
DATE: 3/29/90  
PAGE: 3 of 3

## Synthetic Organic Compounds

	Amount Detected	Detection Limit	Date Analyst
1,2-Dibromo-3-chloro- propane (mg/l)	BDL	0.002	03/07 BAL
1,2,3-Trichloro- propane (mg/l)	BDL	0.001	03/07 BAL
1,2-Dibromoethane (mg/l)	BDL	0.002	03/07 BAL
Chloroform (mg/l)	----	0.001	----
Bromodichloro- methane (mg/l)	----	0.001	----
Chlorodibromo- methane (mg/l)	----	0.002	----
Bromoform (mg/l)	----	0.005	----
1,3-Dichloropropene (mg/l)	BDL	0.001	03/07 BAL

BDL = Below Detection Limit

Samples analyzed according to Method EPA 502.1, "Methods for the Determination of Organic Compounds in Drinking Water", U.S. EPA, December, 1988.



LANAI CO. WELL 8 4954-02

LANAI, HAWAII

TEMPERATURE LOG

April 23, 1990

CALIBRATION DEGREES (F)

60°

70°

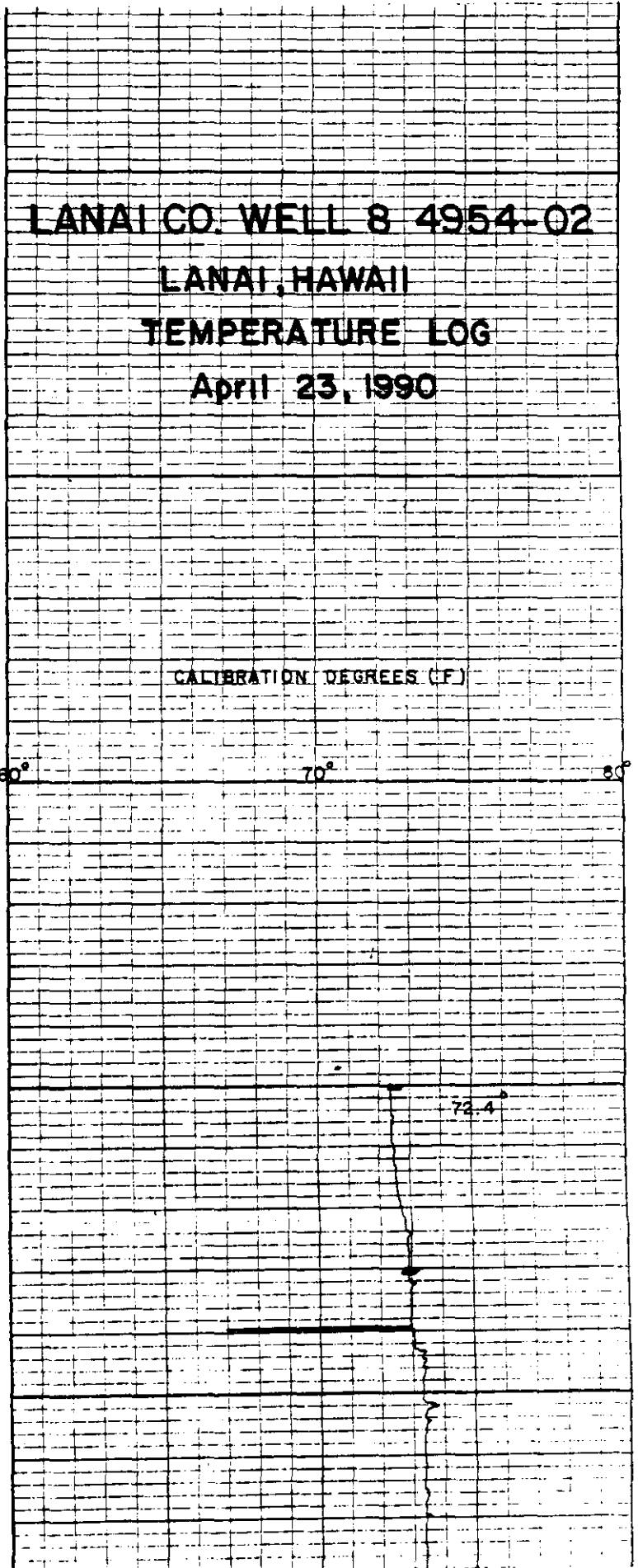
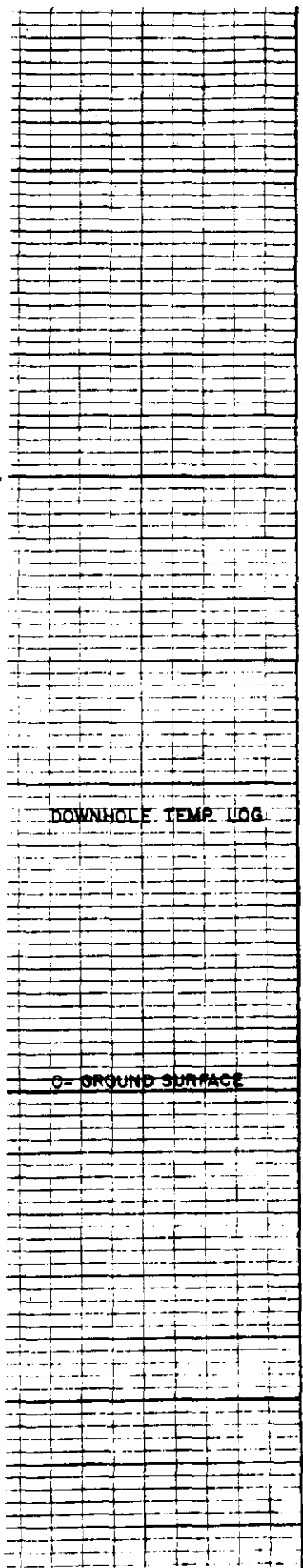
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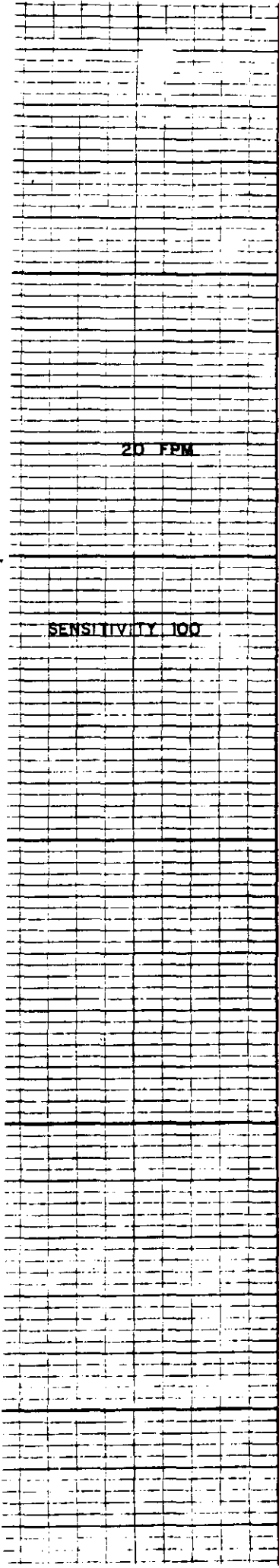
DOWNHOLE TEMP LOG

0 - GROUND SURFACE

0

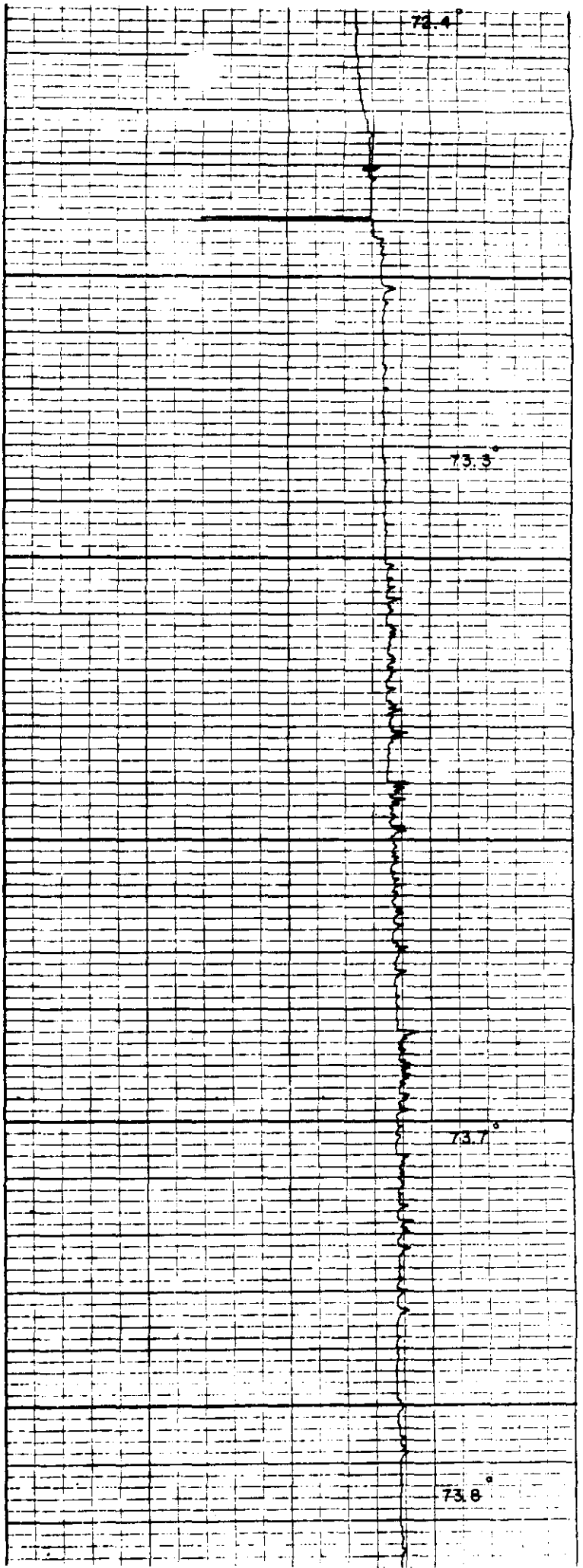
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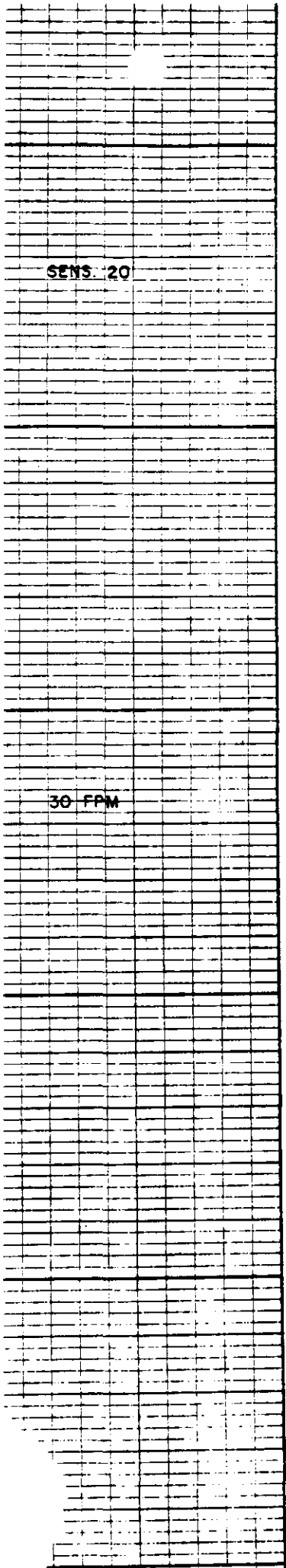




100

200

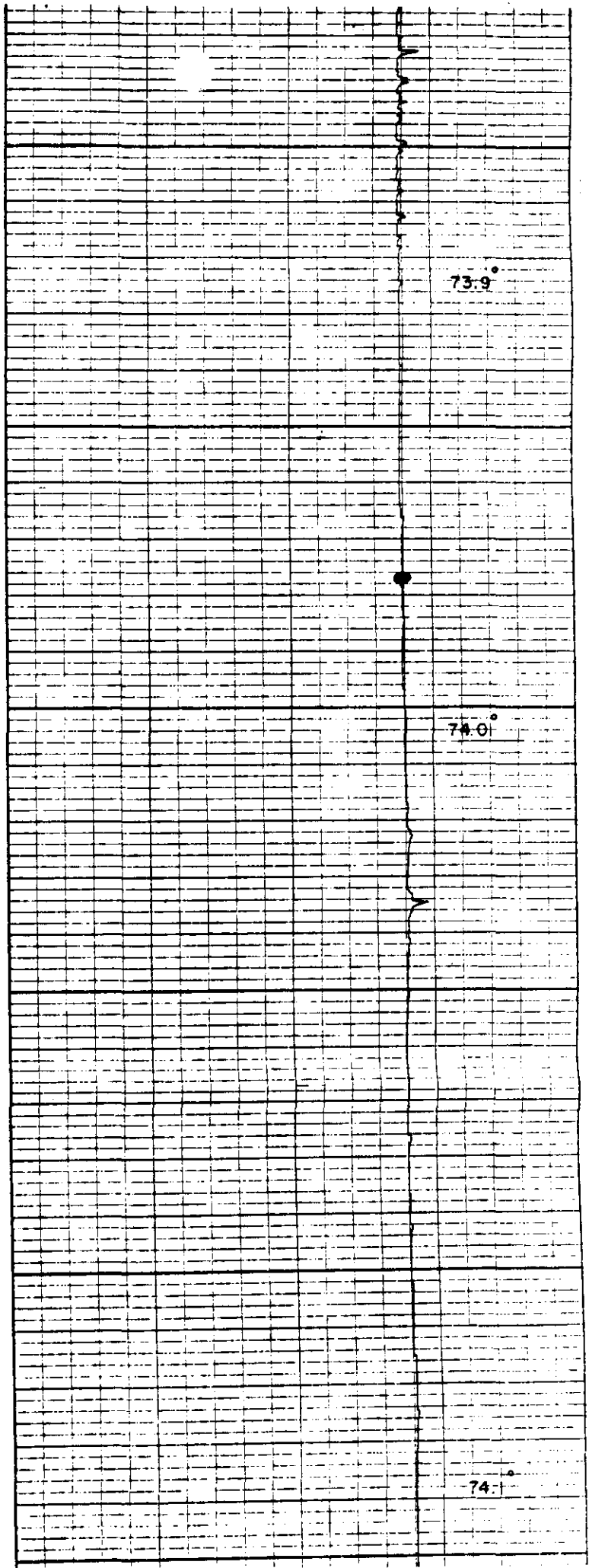


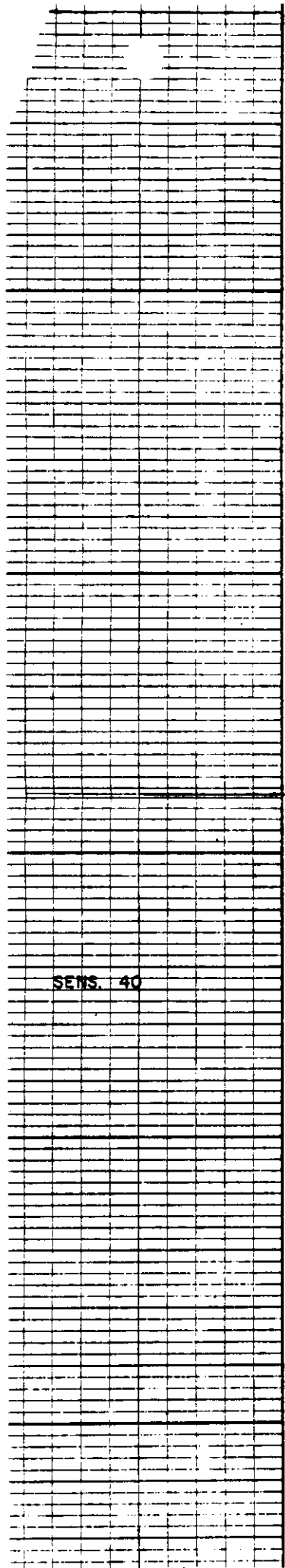


300

400

500



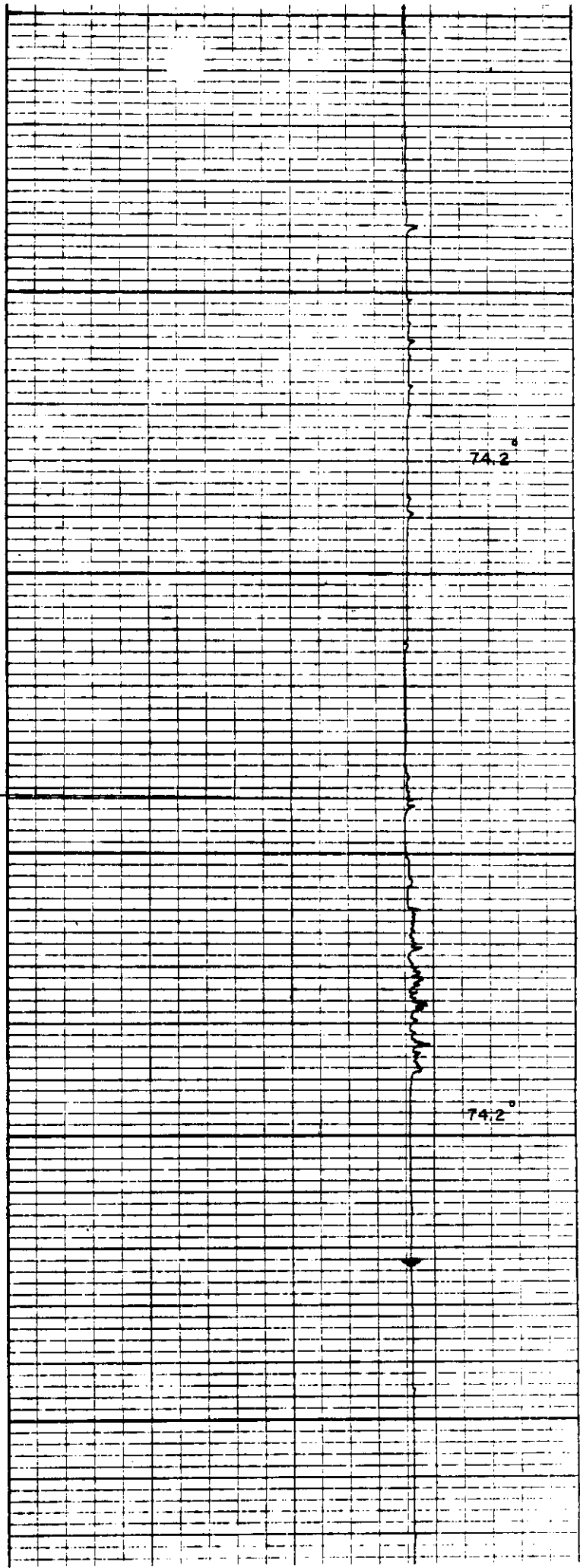


600

700

SENS. 40

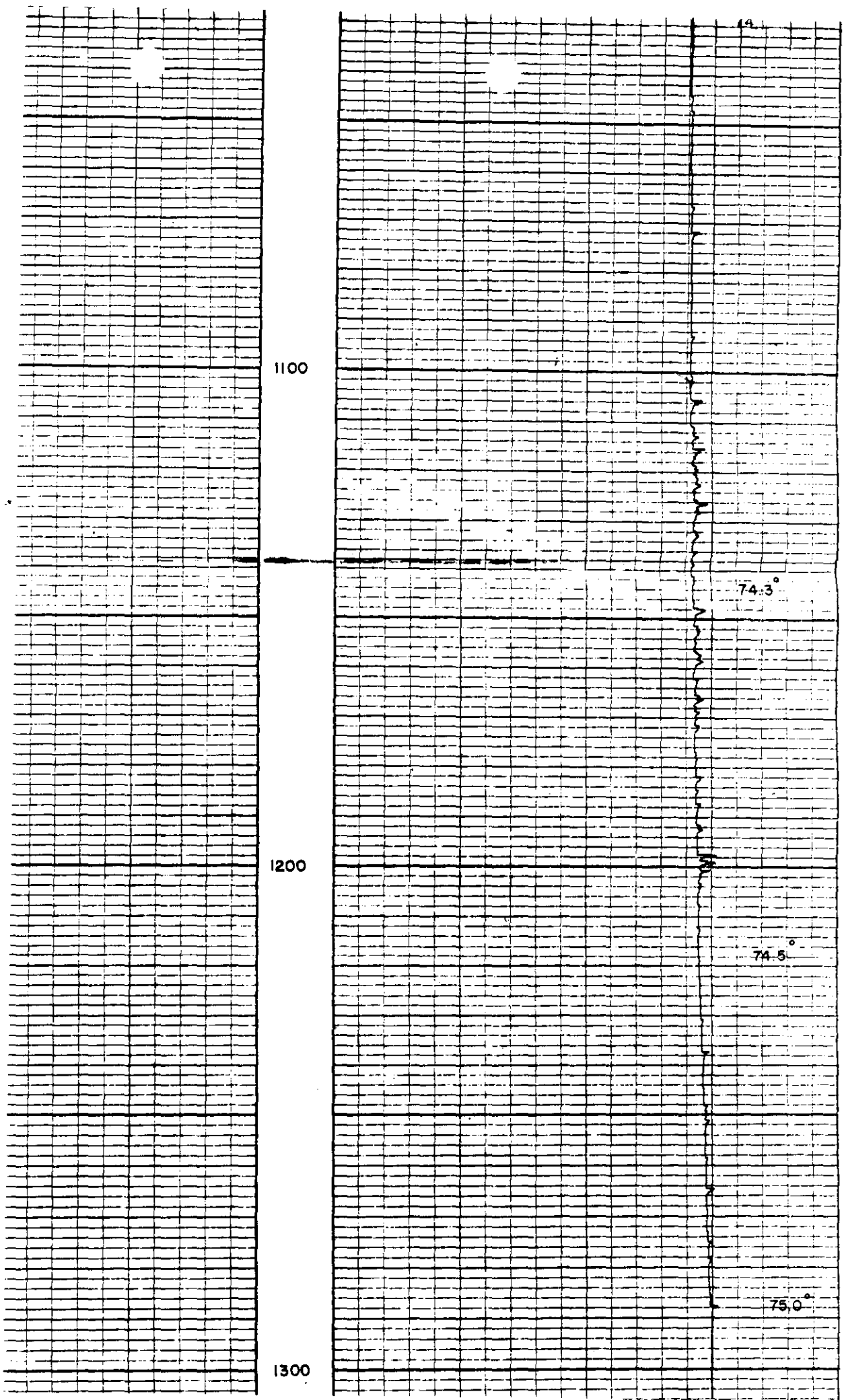
800



74.2

74.2





1100

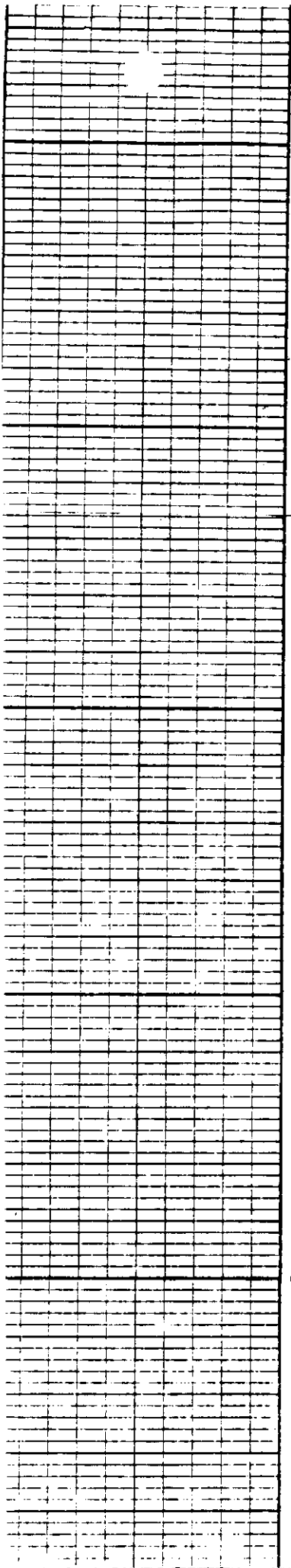
1200

1300

74.3°

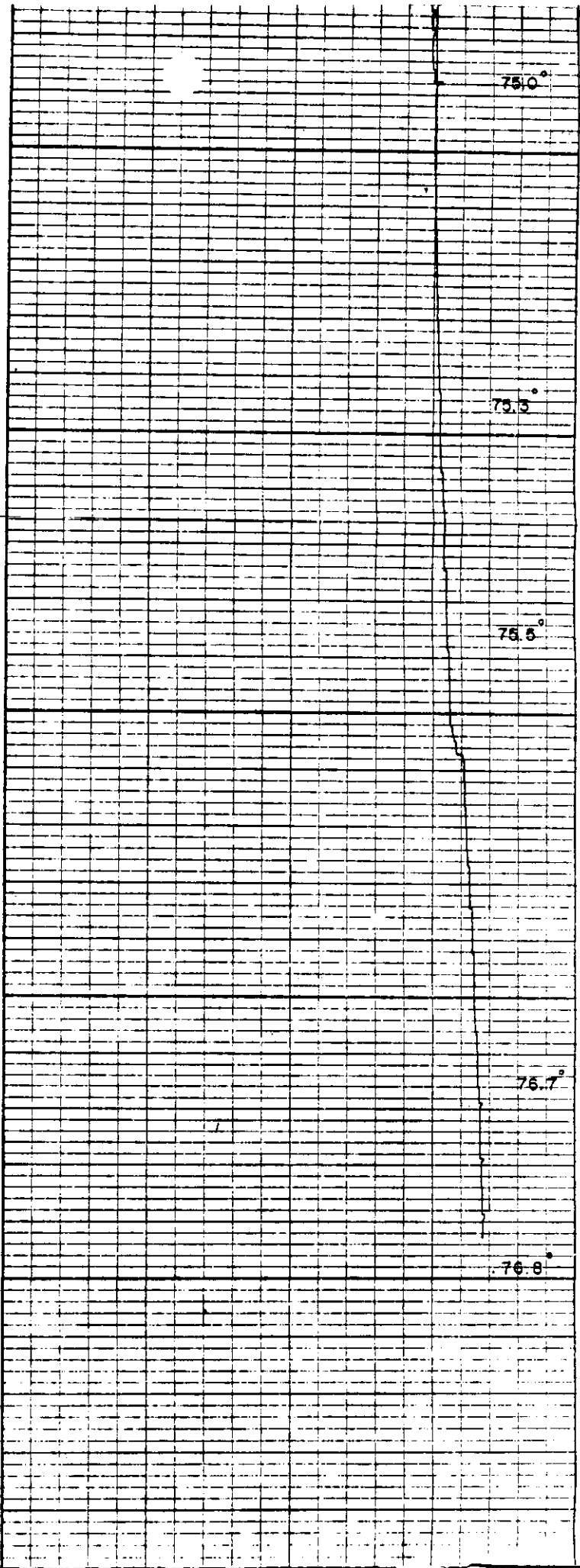
74.5°

75.0°



1300

1400



75.0

75.5

75.8

76.7

76.8

M&E PACIFIC FAX TRANSMITTAL SHEET

TO: Roy Hardy  
FROM: Jim Dexter  
RE: Lanai Well 12 Pump Test

DATE: 4/22/91  
FAX#: 548-6052

This is page 1 of 8 page(s). If you did not receive the total number of pages or transmission was not clear, please phone \_\_\_\_\_ at (808) 521-3051. Thank you.



# **M&E Pacific, Inc.**

*Engineers & Architects*

Suite 500, Pauahi Tower  
1001 Bishop Street  
Honolulu, Hawaii 96813-3497  
(808) 521-3051 FAX (808) 524-0246

December 3, 1990

Mr. John Walker  
Lanai Rock and Concrete Co.  
P.O. Box L  
Lanai City, Hawaii 96763

## **SUMMARY OF WELL 12 PUMPING TEST & RECOMMENDATIONS**

### **Description of Well As Completed To Date**

Well 12 in Kaluakapo Crater (see attached map) was tested on November 27 and 28 by Paul Frandsen & Associates and Jim Dexter. This memo provides you with the results of the test and an analysis of the implications.

The 14-inch well was drilled by the cable tool method 621 feet below the top of collar, approximately 620 feet below ground level. The ground elevation is approximately 605 feet mean sea level (MSL). The bottom of the well is at -15 feet MSL. A 12-inch inner diameter (ID), 3/8-inch thick steel casing has been inserted in the well. The bottom 20 feet of the casing was perforated. One-foot slits (1/4-inch thick) were cut around the circumference of the casing. There are five such slits per one-foot interval; the slits from each interval overlap.

### **Test Setup**

A 400-gallon per minute (GPM) Grundfos submersible pump was used for the test. A five-inch ID steel discharge pipe was used to the top of the well; then a reducer coupled to a three-inch galvanized pipe with gate valve and flow meter were attached. The bottom of the pump was set approximately two feet from the bottom of the well. The air line to measure drawdown was initially set 614.5 feet deep. This proved to be too close to the intake, however, because in combination with the amount of air supplied by the compressor, the pump was unable to move the water column in the discharge pipe due to excessive air entrainment. A smaller compressor and new air line setting 612 feet deep proved to be a workable solution.

# M&E Pacific, Inc.

Mr. John Walker  
 Summary of Well 12 Pumping Test & Recommendations  
 December 3, 1990  
 Page 2

## Test Results

Pumping started at 5:30 P.M. and continued until 7:00 A.M. the following morning. The total duration of the test was 13-1/2 hours. The static water level was approximately 5 feet MSL at the start of the test (a previous measurement estimated the static head at 4.3 feet MSL). Three steps or different flow rates were obtained by manipulating a gate valve on the discharge pipe and taking off sections of the discharge pipe. The drawdown and rates of flow are summarized below:

Flow,GPM	Drawdown,FT	Duration,HR
150	7.7	2
160	8.2	3
190	8.3	8.5

The change in drawdown for the last (190 GPM) step was less than expected and only the first two steps were used as a basis for extrapolating what the drawdown will be at a much higher rate than tested. Another finding provided by the driller was that when the pump was first installed, but not connected to any discharge piping beyond the well head, the pump broke suction after pumping about one minute at its full capacity (400 GPM).

Water samples were collected at the three steps and checked for chloride concentration using a conductivity meter. The estimates ranged from 660 to 570 parts per million (PPM). These values will be verified by lab analysis; experience with our meter indicates it overestimates the chloride level by about 50 PPM. A complete set of water samples for analysis of Safe Drinking Water (EPA) standards was collected at the completion of the test and results will be forwarded when available.

The temperature of the water was 35 degrees centigrade, about 95 degrees Fahrenheit. However, the water was extremely clear, free of any turbidity or color.

## Decision Required On Kaluakapo Crater Development

The original purpose for this well was exploration for an alternate source of water that could be exploited to provide irrigation for the Manele Project Development and would not withdraw water from available reserves in the high level aquifer. This

# M&E Pacific, Inc.

Mr. John Walker  
Summary of Well 12 Pumping Test & Recommendations  
December 3, 1990  
Page 3

objective has been met; the well confirms:

1. The Kaluakapo Crater area is an alternate source based upon the basal head (+4 feet MSL) and the brackish water encountered.
2. Wells can be developed that have moderate yields and suitable quality for irrigation, certainly better than the experience with Well 10. Recall at the latter well, the results of the pump test showed 6.4 feet of drawdown at only 46 GPM and chloride concentrations between 1400 to 1700 PPM.

The southeast rift zone of the Lanai crater, along which the Kaluakapo Crater is situated, now appears as a better candidate for developing irrigation supplies. The major decision for Lanai Co. at this time is commitment to use the water with the attendant costs to complete development.

A complete review of all the options for developing irrigation supplies, including use of brackish wells already completed along the rim of the Palawai Basin, is beyond the scope of this memo; however, if the decision is made to use the Crater source, there are several actions that need to be considered in the immediate future.

## Completion of Well 12

Assuming the crater source will be developed, the recommendation is to complete this well for future use as an irrigation source for the Manele Project Development. The recommended rated capacity for the pump is 200 GPM. On a 24-hour basis, this will provide 0.29 million gallons per day (MGD).

Using the above drawdown results, the estimated range of drawdown at 200 GPM is between 8.3 to 10.9 feet. Assuming the worst case, approximately 11 feet with rounding, the final production pump (if set as during this test) would have approximately 6 feet of submergence over the top of the intake.

Manufacturer's recommendation is for a minimum of 10 feet, with 20 feet being optimum, submergence for a pump with this rated capacity assuming a 50 horsepower motor. In order to provide this minimum submergence the well must be deepened.

## M&E Pacific, Inc.

Mr. John Walker  
Summary of Well 12 Pumping Test & Recommendations  
December 3, 1990  
Page 4

We recommend deepening the well 10 feet, to a new bottom elevation of -25 feet, MSL. Thus the expected submergence would be approximately 15 to 16 feet.

The requirement to case the deepened portion of the well should await the driller's recommendation after the work is completed. If the drilling is through hard lava rock, and the water pumps relatively clean, this portion of the well can be left open.

The production pump should be selected and ordered now so that the pump can be installed prior to the removal of the drill rig from the crater. The driller has obtained some preliminary cost information which he can provide directly to you for budgeting purposes.



James S. Kumagai, Ph.D.  
Vice President

JSK/JRD/lt





# AECOS

970 N. Kalaheo Avenue, Suite A200 • Kailua, Hawaii 96734  
 Telephone: (808) 254-5884

JOB NO.: 457  
 DATE: 1/7/90  
 PAGE: 1 of 3

TO: M & E Pacific

ATTN: Jim Dexter

SAMPLE SITE: Lanai Well #12

RECEIPT DATE: 11/28/90

DATE SAMPLED: 11/27/90

TIME SAMPLED: ----

LOG #: 4729

SAMPLED BY: Jim Dexter

## LABORATORY ANALYSIS REPORT - Primary Drinking Water Standards

	Amount Detected	Detection Limit	Date Analyst
Arsenic (mg/l)	BDL	0.005	12/21 HECO
Barium (mg/l)	BDL	0.05	12/21 HECO
Cadmium (mg/l)	BDL	0.001	12/21 HECO
Chromium (mg/l)	BDL	0.001	12/21 HECO
Lead (mg/l)	BDL	0.005	12/21 HECO
Mercury (mg/l)	BDL	0.0005	12/21 HECO
Selenium (mg/l)	BDL	0.005	12/21 HECO
Silver (mg/l)	BDL	0.001	12/21 HECO
Fluoride (mg/l)	0.1	0.1	11/30 klm
Nitrate (mg N/l)	3.22	0.03	11/28 dh
Turbidity (NTU)	2.02	0.1	11/28 klm
Endrin (mg/l)	BDL	0.0001	12/10 er/mm
Lindane (mg/l)	BDL	0.00005	12/10 er/mm
Methoxychlor (mg/l)	BDL	0.0003	12/10 er/mm
Toxaphene (mg/l)	BDL	0.002	12/10 er/mm
2,4-D (mg/l)	BDL	0.002	11/21 HECO
2,4,5-TP (mg/l)	BDL	0.0004	11/21 HECO

BDL - Below Detection Limit

Samples analyzed according to "Methods for Chemical Analysis of Water and Wastes", U.S. EPA, March, 1979 and/or "Methods for Organochlorine Pesticides and Chlorophenoxy Acid Herbicides in Drinking Water and Raw Source Water", U.S. EPA, July, 1978.

JOB NO.: 457  
LOG #: 4729  
PAGE: 2 of 3

**Secondary Drinking Water Standards**

	Amount Detected	Detection Limit	Date Analyst
Alkalinity (mg CaCO <sub>3</sub> /l)	140	5	12/11 er
Calcium Hardness (mg CaCO <sub>3</sub> /l)	255	0.5	12/11 er
Chloride (mg/l)	707.5	5	12/10 klm
Color (APCU)	BDL	10	12/3 er
Copper (mg/l)	BDL	0.01	12/21 HECO
Total Dissolved Solids (mg/l)	1030	10	12/12 er/klm
Iron (mg/l)	0.319	0.02	12/21 HECO
Manganese (mg/l)	BDL	0.01	12/21 HECO
pH	7.34	0.1	11/28 klm
Sulfate (mg/l)	14.0	2	12/3 klm
Zinc (mg/l)	BDL	0.05	12/21 HECO

BDL = Below Detection Limit

Samples analyzed according to "Methods for Chemical Analysis of Water and Wastes", U.S. EPA, March 1979

JOB NO.: 457  
 LOG #: 4729  
 PAGE: 3 of 3

### Synthetic Organic Compounds

	Amount Detected	Detection Limit	Date Analyst
Chloroform (mg/l)	<2	2	12/21 HECO
Bromodichloro- methane (mg/l)	<2	2	12/21 HECO
Chlorodibromo- methane (mg/l)	<2	2	12/21 HECO
Bromoform (mg/l)	<2	2	12/21 HECO
Total Trihalo- methane (mg/l)	<8	8	12/21 HECO

BDL = Below Detection Limit

Samples analyzed according to Method EPA 502.1, "Methods for the Determination of Organic Compounds in Drinking Water", U.S. EPA, December, 1988.

Conductivity (umhos/cm)	1790	----	12/10 klm
Silica (mg/l)	105	----	1/4 BAL
Magnesium (mg/l)	42.8	----	11/27 HECO