UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TESTS OF ARTESIAN WELLS IN THE COLD CREEK AREA, WASHINGTON

By

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58-46

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INTRODUCTION

By letter dated October 22, 1951, to the Engineering and Construction Division of the AEC Hanford Operations, Mr. Norman G. Fuller, Chief, Real Estate Branch of AEC Hanford Operations, requested that the Geological Survey make capacity-flow test measurements to determine the yield of wells in the upper Cold Creek area of the AEC Hanford Reservation environs.

Location of Area and Wells

Cold Creek valley is in the south-central part of Washington State, about 40 miles east of Yakima. The area of artesian wells occurs near the mutual corner of the Townships 12 and 13 N., Ranges 24 and 25 E. (See plate 1.)

The wells involved are in an area about three (3) miles long and one-half (1/2) mile wide in the upper half of the valley. They are as follows:

(1) Ford well, Tract JJ-671 in the SW¼NW¼ of section 25, Township 13 N., Range 24 E., 3/8 mile south of the northwest corner of Section 25, referred to in this report as well 13/24-25E1.

(2) McGee well, Tract JJ-677 in the SW¼SW¼ NE¼ of Section 30, Township 13 N., R. 25 E., about 300 feet north of the center of the section, referred to in this report as well 13/25-30G1

(3) Enyeart well, Tract JJ-667 in the NW¼NW¼ of Section 36, Township 13 N., Range 24 E., 150 feet southeast of the NW corner of Section 36, referred to in this report as well 13/24-36D1.

(4) O'Brian well, Tract JJ-669 in the SW¼NE¼ of Section 26, Township 13 N., Range 24 E., referred to in this report as well 13/24-26G1.

(5) Brown well, Tract JJ-667 in the NW¼SW¼ of Section 26, Township 13 N., Range 24 E., 75 feet southeast of the west quarter corner of Section 26, referred to in this report as well 13/24-26M1.

(6) Lemcke well, not requested in the flow-test, but available as an observation well in the NW¼SE¼ of Section 27, Township 13 N., Range 24 E., referred to in this report as well 13/24-27K1.

Well-Numbering System

In this report, each well is designated by a symbol which indicates its location according to the official rectangular survey of public lands. For example, the symbol 13/24-25E1 refers to a well in sec. 25, T. 13 N., R. 24 E. The letter after the section number refers to a 40-acre subdivision of the section according to the following diagram and the number one (1) indicates that it was the

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

first well visited in that particular 40-acre tract. The townships are north from the Willamette base line and the ranges are east of the Willamette meridian.

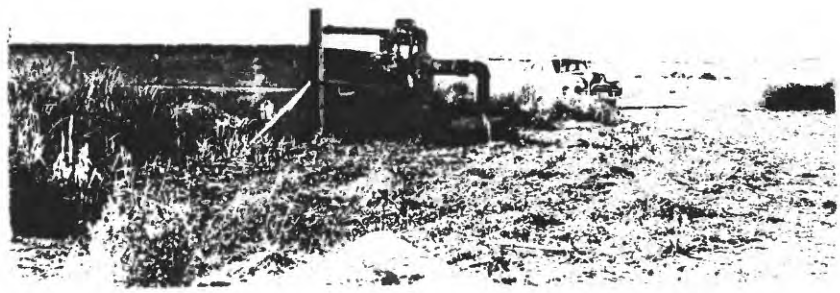
DESCRIPTION OF TESTS

Rectangular weirs having end contractions were designed for each well from theoretical flow calculations. A 90° V-notch weir was designed to measure the stream flowing from the leak in the Ford well (13/24-25E1) (pls. 8 to 11). Weirs were built by the General Electric Co.

Each weir was placed on a timber foundation. After the weirs had been leveled, vertical tape gages were fastened to one side of the weir boxes approximately five feet back from the weir plate. The gages were adjusted to read zero when the water was level with the crest of the weir plate.

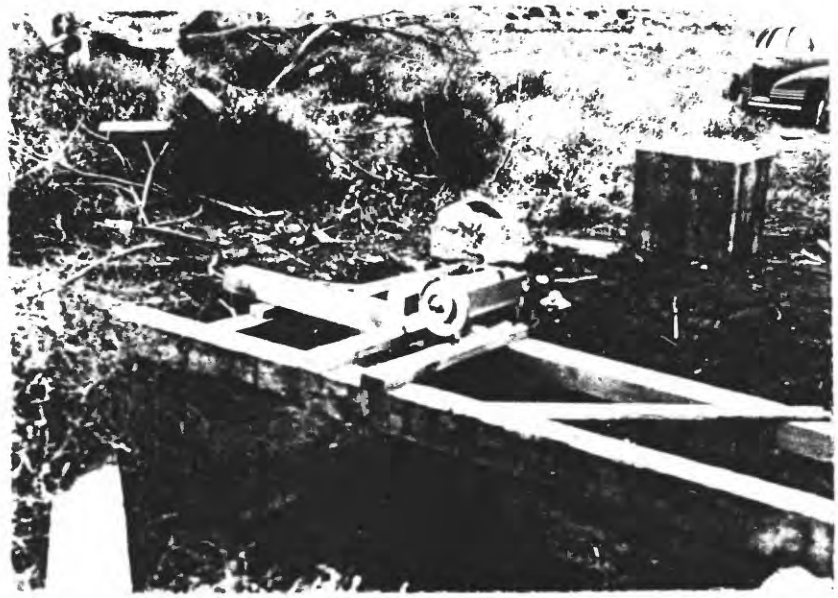
Each weir was placed within a few feet of its respective well except the one for the Ford well (13/24-25E1). The closest convenient location for this weir was about 1,000 feet due south of the well with the water being taken from a standbox on a 10-inch irrigation pipe line from the well (pl. 2). The leak from the Ford well was measured by a weir on the surface about 200 feet southeast of the well.

The Brown well (13/24-26M1) and the Lemcke well (13/24-27K1), having static water levels considerably below the land surface, were used as observation wells during the tests. A Stevens automatic water-level recorder and a Fries automatic water-level recorder were placed in operation on the Lemcke well (13/24-27K1) and the Brown well (13/24-26M1), respectively (pl. 3). At various times during the tests the water levels in those wells were measured with a hand tape to check the accuracy of the recorders.

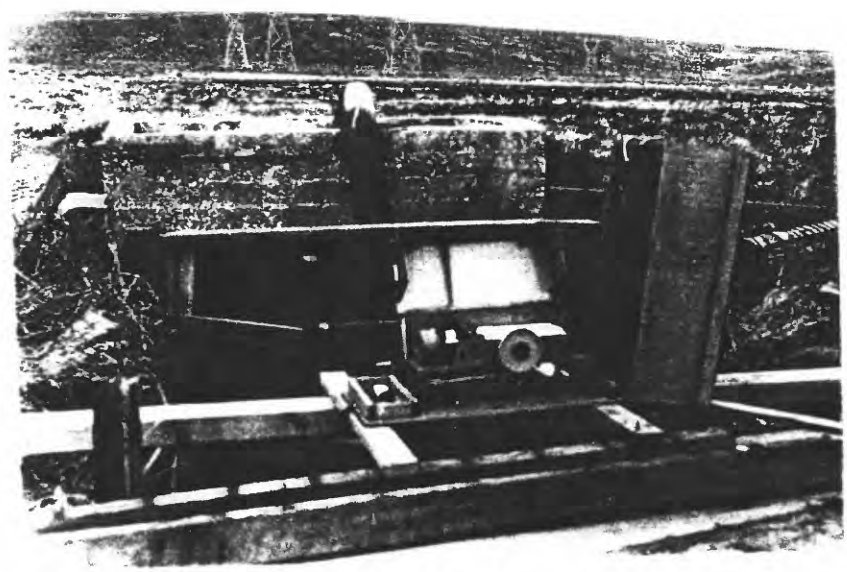


(A) Photo of the Ford well (13/24-25Q1). View west up the valley.

(B) Photo of the 24-inch rectangular weir to measure discharge of the Ford well (13/24-25E1). Discharge is 740 gpm.



(A) Photo of the Brown well (13/24-26M1) showing Friez automatic water-level recorder over 16-inch well casing.



(B) Photo showing Stevens automatic water-level recorder in operation over the Lemcke well (13/24-27K1).

The altitudes for the discharge point or measuring point of the wells were established by running spirit levels of third-order accuracy from the U. S. Coast and Geodetic Survey bench marks (shown on pl. 1).

The altitudes of the water level, or hydrostatic pressure level, in the wells on November 28, 1951, (prior to tests) were found to be 1,003.62 feet in well 13/24-36D1; 1,000.72 feet in well 13/25-30G1; 1,005.79 feet in well 13/24-26M1; 1,005.98 feet in well 13/24-27K1; 962.20 feet in well 13/24-25L1 (well casing leaking 500± gallons per minute), and 985.74 feet for well 13/24-26G1.

Calculations

The Francis formula, $Q = 3.33 (L-0.2H) H^{3/2}$, for weirs having end contractions was used to compute the flow from wells tested.

Explanation of terms used in the Francis formula are as follows:

Q = flow in cubic feet per second.

L = actual length of weir crest in feet.

H = head on weir crest in feet (gage reading).

3.33 = coefficient of discharge developed by Francis.

The weirs were designed so that the velocity of the water's approach to the weir plate was negligible, therefore, it was unnecessary to make a correction for it.

Flow from the Ford well (13/24-25L1) leak was computed from the formula, $Q = 2.53 H^{5/2}$ for a 90° V-notch weir.

These formulas are commonly accepted as giving results from properly designed weirs correct to within ±3 percent. Weirs used for those tests were designed and built according to the accepted method.[a/]

a/ U.S.G.S. Water-Supply and Irrigation paper no. 200, Weir Experiments, Coefficients, and Formulas, p. 44.

Tests

The discharge measurements were started November 28, 1951, after measurements of shut-in pressure had been made at all the flowing wells and the recorders started on the observation wells.

Each well in succession was allowed to flow separately for 24 hours. During the test of each well, readings in feet above land surface were made of the shut-in pressure in the other three wells. From 15 to 30 minutes after each well had been opened the flow stabilized and remained fairly constant throughout the test. Only the Ford well (13/24-25M1) showed any great variation in discharge, probably due to the leakage flowing from a casing break, reported to be about 50 feet below the surface.

After the end of the individual tests all the wells were opened together and allowed to flow simultaneously for 48 hours. The measurements show that a slight decline in flow discharge occurred in each well during the 48-hour test. Toward the end of the 48-hour test the discharge of the wells apparently, was still subsiding slightly.

The graphs showing the fluctuations of the water level recorded in the Brown well (13/24-26M1) and Lemcke well (13/24-27K1) during the tests are shown on plates 4 and 5.

CONCLUSION

The following table is a summary of the flow data given in Table 1.

Summary of Flow Data of Cold Creek Wells

Measurement at end of 24 hours Wells flowing separately				Measurement at end of 48 hours All wells flowing simultaneously			
Well No.	Date	Hour	Gpm	Well No.	Date	Hour	Gpm
13/25-30G1	12/ 1/51	3:07 P	919	13/25-30G1	12/ 5/51	3:00 P	903
13/24-36D1	11/29/51	12:53 P	386	13/24-36D1	12/ 5/51	2:50 P	377
13/24-25E1*	11/30-51	1:50 P	1,043.5	13/24-25E1*	12/ 5/51	2:40 P	1,046
13/24-26G1	12/ 3/51	10:25 A	126	13/24-26G1	12/ 5/51	2:28 P	115
Total flow,			2,474.5				2,441

*Flow from well plus leak (2 weir measurements combined).

Appendix I

History of Wells

This history is compiled from the files of the U. S. Geological Survey largely from notes made by George C. Taylor, Jr., in 1943.

Of the six (6) wells tapping the artesian zone in the Columbia River basalt below the upper Cold Creek valley only four (4) are now, December 1951, flowing at the land surface. They are (1) 13/25-30G1, (2) 13/24-25E1, (3) 13/24-36D1, (4) 13/24-26G1. The other two wells, 13/24-26M1 and -27K1, formerly flowed but their water levels have since declined to a level below the land surface.

The first well drilled in the area was the Brown well (13/24-26M1) in October, 1918 (by N. C. Jannsen Drilling Co.). It is reported to have had a water-pressure level about 92 feet above land surface when drilled. In March 1943, Taylor measured a water level of 26.15 feet below land surface. The water level was 40.4 feet below land surface on November 28, 1951. The driller's log of the Brown well is given in table 3.

The Lemoke well (13/24-27K1) was drilled in 1921 (driller unknown) and originally had a water-pressure level approximately 23 feet above land surface. On November 28, 1951, the water level was 86.7 feet below land surface.

The O'Brian well (13/24-26G1) was drilled in 1922 by N. C. Jannsen Drilling Co. (pl. 6). In March 1942, Taylor measured a water level of 46.6 feet above land surface. On November 28, 1951, water level was 13.5 feet above land surface. The O'Brian well may be partially plugged or obstructed.

Unpublished records subject to revision

Photo of the O'Brian well (13/24-26G1) with 18-inch weir box (facing away from reader) in position for tests.

The Ford well (13/24-25r1) was drilled in 1925 by George Scott. Water-pressure level was then 215 feet above land surface according to the reports by Scott. From an orifice flow test made by Scott in 1925, the flow was reported to be about 3,900 gpm. On November 28, 1951, the water level was about 38 feet above land surface and the well-leak stream measured some 590 gpm. After tests had been run the leak had increased to a measured 647 gallons per minute and the water level in the well had risen to 4 feet above land surface. The driller's log of the Ford well is given in table 3.

The McGee well (13/25-30G1), drilled in April 1927 by Frank A. Lawson, had a reported initial water-pressure level of about 212 feet above land surface (pl. 7a). On November 28, 1951, the water level was 65 feet above land surface. The driller's log is given in table 3.

The A. E. Knyeart well (13/24-36D1) was drilled in November 1922 by N. C. Jannsen (pl. 7b). Original water level and flow are unknown but according to driller's log (see table 3) the flow was heavy. On November 28, 1951, the water level was approximately 92 feet above land surface.

It is reliably reported that the wells were allowed to flow free much of the year around until sometime in the 1930 decade when capping and closing was required by the State Supervisor of Hydraulics. In the last two years the water from the McGee (13/24-30G1), Ford (13/24-25r1), and A. E. Knyeart (13/24-36D1) wells has been used for irrigation in an amount roughly estimated as 700 to 1,200 acre-feet per year. The leakage to waste from the Ford well was about 500 acre-feet per year. Thus a total ground-water withdrawal of 1,200 to 1,700 acre-feet per year is roughly estimated for the years 1950 and 1951.

Unpublished records subject to revision.

(A) Photo of the McGee well (13/25-30G1) showing water discharge of 919 gpm (gallons per minute) through a 30-inch rectangular weir.

(B) Photo of the Enyeart well (13/24-36D1). View northwest across the valley. Discharge is 386 gpm through a 12-inch rectangular weir.

Appendix II

Tabulated Information

Table 1 is a description of wells in the area.

Table 2 gives the discharge measurement made for each of the four flowing wells and the altitude of water levels measured with a hand tape in the observation wells.

Table 3 contains the drillers' logs for wells 13/24-26M1, 13/24-36D1, 13/24-25E1, and 13/25-30G1.

Table 4 gives chemical analyses (made by the Geological Survey) of water from wells 13/24-26G1, 13/25-30G1, 13/24-25E1, and 13/24-36D1.

Plates 8 through 11 are drawings of the weirs and gages used in the tests.

Table 3.- Drillers' Logs of the Wells

13/24-25F1. Formerly Jerry Ford. Drilled by George Scott, August 1925

Materials	Thickness (feet)	Depth (feet)
Soil (clay)	16	16
Gravel, dirty, some boulders	157	173
Basalt, black and gray, hard	322	495
Shale, blue, sticky, and blue sandy shale, 40 feet of coarse granite sand, some brownish shale on top of rock	130	625
Basalt, hard, water-bearing, flow gradually increased to 285 gpm	23	648
-------, no water increase	68	716
-------, no data	2	718
-------, water increased from 285 gpm to 13 lbs. pressure on 7⅛-inch diameter orifice flow meter, water increased to last of drilling .	59	777

Cased to 625 feet with 10-inch, 35-pound line pipe, 10-inch hole.

13/24-26M1. Formerly Archie Brown. Drilled by N. C. Jannson Drilling Co., October 1918

Soil	8	8
Gravel and boulders	172	180
Basalt, hard	247	427
Cavity, water-bearing	½	427½
Not reported	50½	478
Sandstone	14	492
Shale, blue	75	567
Sand	6	573
Shale, blue	10	583
Shale, brown	9	592
Shale, green	6	598
Basalt, honeycombed, water-bearing	70	668

Strong flow broke in at 668 feet, 40 lbs. pressure.

Table 3.- Drillers' Logs of the Wells - Continued

13/24-36D1.- Formerly H. R. Anyeart. Drilled by N. C. Jannsen Drilling Co., November 1922

Materials	Thickness (feet)	Depth (feet)
Soil and hardpan	10	10
Gravel	50	60
Sand and clay	68	128
Gravel	23	151
Basalt, black	165	316
Yellow clay, sticky	59	375
Blue clay	10	385
Black basalt	14	399
Sand	3	402
Sand and gravel	15	417
Blue basalt	69	486
Soft (material)	7	493
Fine sand	5	498
White, coarse sand	1	499
Sand	1	500
Fine sand	4	504
Gray basalt	19	523
Soft conglomerate	24	547
Gray basalt, fractured (bad crevice at 557 ft)	35	582
Black basalt, hard	103	685
Gray basalt	29	714
Black sand formation	3	717
Gray basalt	9	726
Blue basalt	19	745
Gray basalt	83	828
Gray rock similar to sand rock	5	833
White sand	9	842
Sand	8	850
Sand and clay	5	855
Gray water sand	13	868
(water raised to within 30 ft of top)		
Blue clay	4	872
Sand and clay	10	882
Clay	8	890
Sand and clay	7	897
Sand	3	900
Clay	14	914
Sand	9	923
Clay	3	926
(Water comes within 15 ft of top)		
Sand and clay	10	936
Clay, blue, sticky	6	942
Brown clay and petrified wood	12	954
Green shale (water flowing over casing 3-4 gpm)	7	961
Sand	2	963

Table 3.- Drillers' Logs of the Wells - Continued

13/24-36D1 - Continued

Materials	Thickness (feet)	Depth (feet)
Black basalt, hard, fractured (struck a small seam in rock at 973 ft and flow increased from about 18 to 25 gpm. Before reaching base of this member, flow had increased to 50 gpm) . .	93	1,056
Soft seam or crevice	1	1,057
Hard streak	1	1,058
Soft streak	½	1,058½
Hard streak	1½	1,060
Basalt, hard, crevices	22	1,082
Basalt, honeycombed (heavy flow of water)	2	1,084
Hard ground	1	1,085
Basalt with some petrified wood	3	1,088
Basalt, wood, and a little green shale (water got so strong at 1,092 ft that tools would not drop any further)	4	1,092

935 ft 4½-inch casing (inside of larger casing at top of hole).

Table 3.- Drillers' Logs of the Wells - Continued

13/25-30G1. Formerly C. L. McGee. Drilled by Frank R. Lawson, April 1927

Materials	Thickness (feet)	Depth (feet)
"Surface"	22	22
Clay and boulders	316	338
Clay, blue, green, and yellow	240	578
Basalt, black, with soft seams	34	612
Clay, blue, hard and sandy	10	622
Clay, sticky, blue and variegated	22	644
Clay, sticky, blue	26	670
Shale, soft, with "soapstone float"	10	680
Rock, water-bearing	25	705
Basalt, black, increase in water flow	115	820
Basalt, broken, increase in water flow	4	824
Clay, soft, with "broken rock" (no water)	26	850
"Lake bed with wood," layers of green clay	10	860
Basalt, black and broken, increase in flow of water	65	925
Basalt, hard, black	25	950
Basalt, black and "broken," increase in flow of water	25	975
Basalt, broken, increase in flow of water	15	990
Basalt, broken	8	998
Sand, fine, "heavy flow" of water	1	999
Porous rock, "heavy flow" of water	101	1,100
Sand, fine	10	1,110

Table 4.- Chemical Analyses of the Ground Water for the Flow-Tested Wells
[Analyses by Geological Survey, United States Department of the Interior] (Parts per million, except for last four items)

Well number (U.S.G.S.)	13/24-26G1	13/25-30G1	13/24-25E1	13/24-26D1
Salt Lake City Lab.no.	7868	7869	7870	7871
Date of collection	12/1/51	12/1/51	11/30/51	11/29/51
Silica (SiO_2)	60	62	65	64
Iron (Fe) (Sol)	.06	.02	.02	.03
Calcium (Ca)	20	17	19	18
Magnesium (Mg)	12	9.4	12	11
Sodium (Na)	27	30	27	29
Potassium (K)	6.7	9.9	8.5	6.7
Manganese (Mn) Total	.00	.00	.00	.00
Bicarbonate (HCO_3)	193	181	189	184
Sulfate (SO_4)	1.5	1.6	1.8	1.8
Chloride (Cl)	5.5	4.8	5.8	5.4
Fluoride (F)	.5	.6	.5	.6
Nitrate (NO_3)	.0	.1	.1	.1
Boron (B)	.07	.05	.06	.07
Dissolved solids:				
sum - ppm	228	225	233	227
- tons/a.ft	.31	.31	.32	.31
Hardness as $CaCO_3$				
Total,	99	81	97	90
Noncarbonate,	0	0	0	0
Specific conductance (Micromhos at 25°C)	292	277	215	277
Percent sodium	35	41	35	39
pH	7.8	7.8	7.8	7.7
Temperature, °F (when sampled)	68	80.5	74.8	74.5

Unpublished records subject to revision

Table 1.- Description of the Wells

U. S. Geological Survey well number	Name of former owner	Topography and approximate altitude (ft above sea level)	Type	Depth (feet)	Diameter (inches)	Depth of casing (feet)	Water-bearing zone or zones: Depth to top (feet)	Water-bearing zone or zones: Thickness (feet)	Water-bearing zone or zones: Character of material	Water-bearing zone or zones: Ground-water occurrence	Water level: Feet below land-surface datum	Water level: Date	Type of pump	Use	Chemical character in parts per million: Hardness	Chemical character in parts per million: Chloride	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
		T. 13 N., R. 25 E.															
30G1	C. L. McGee	Vf 835.55	Dr	1,110	8		700	410	Basalt	Confined	*165	Nov. 28, 1951	N	Irr	94	5	
		T. 13 N., R. 24 E.															
25E1	Jerry Ford	Vf 923.85	Dr	777	10	625	625	152	do.	do.	* 35.8	Nov. 28, 1951	N	Irr	98	5	Flow of 590 gallons per minute from leak in casing 50± ft below surface.
26G1	O'Brian	Vf	Dr	697	10-5/8				do.	do.	*13.5	Nov. 28, 1951	N	Irr	98	5	Well may be partially obstructed; well leaking 20± and 65± gallons per minute, respectively, before and during tests.
26M1	Archie Brown	Vf 1,046.19	Dr	668	16		598	70	do.	do.	40.4	Nov. 28, 1951	N	N			
27K1	H. M. Leucke	Vf 1,092.61	Dr	625	8				do.	do.	86.6	Nov. 28, 1951	N	N			
36D1	H. R. Enyeart	Vf 909.23	Dr	1,092	4.5	936	936	156	do.	do.	*92	Nov. 28, 1951	N	Irr	94	5	

Vf, valley floor.
Dr. drilled.
* Water level above land surface taken with Ashcroft pressure gauge.

Table 2.- Flow Capacity Tests - Well 13/24-36D1

Measurements made with a 12-inch rectangular weir having end contractions. Altitude of land surface at well = 909.23 ft; altitude of discharge = 913.73 ft; temperature of water at well = 74.5°F; altitude of initial pressure head in well = 1,003.82 ft.

		Well discharge		Altitude of pressure head (in feet)					Leak in GPM	
				Observation wells			Leaking wells			
Day	Hour	Cu ft/sec	GPM	13/25-30C1	*13/24-26M1	*13/24-27K1	13/24-25E1	13/24-26C1	13/24-25E1	13/24-26C1
11/28/51	10:35 A.M.	[illegible]			1,005.79	1,005.98				
[illegible]	10:55(1)	0.775	349	1,000.72	1,005.79	[illegible]	962.20	985.74	590	65
	10:57	.775	349							
	10:58	.858	386							
	11:00	.858	386	1,000.72			962.20		590	
	11:45	.858	386	1,000.72				985.74		65
	12:05 P.M.				1,005.76		962.20		590	
	12:17					1,005.88				
	1:00	.858	386	1,000.72			962.19	985.74	590	65
	1:25	.858	386		1,005.69	1,005.84				
	2:30	.858	386							
	3:30						962.17			
	4:16			999.56						
11/29/51	9:10 a.m.			998.41						
	9:20	.858	386							
	9:25						961.80		590	
	11:40				1,005.39			985.74		65
	11:51					1,005.56				
	12:45 P.M.	.858	386	998.41				985.74		65
	12:53(2)	.858	386							

(1) Well opened; only well flowing except leak from -25K1 and small leak from -26C1.
(2) Well shut off.
* Nonflowing wells with automatic water-level recorders attached; altitude of measuring point and land surface at well 13/24-26M1 = 1,046.19 ft, and well 13/24-27K1 = 1,092.61 ft.
GPM means gallons per minute.

Table 2.- Flow Capacity Tests - Well 13/24-25E1

Measurements made with a 24-inch rectangular weir having end contractions; altitude of land surface at well = 923.85 ft; altitude of discharge = 922.13 ft; altitude of initial water pressure head in well = 962.20 ft; temperature of water at weir (1,000 ft from well) = 74.8°F

Date		Well discharge			Altitude of pressure head (in feet)				Leaking well	Leak, in GPM
					Observation wells					
Day	Hour	Cu ft/sec	GPM	Leak, in GPM	13/25-30G1	13/24-36H1	*13/24-26J1	*13/24-27K1	13/24-26G1	13/24-26G1
11/29/51	1:30 P.M.			590	998.41	1,001.13			985.84	65
	2:09(1)			590	998.41	1,001.13			985.84	65
	2:21	1.48	666	590						
	2:25			580.5						
	2:28			553.5						
	2:30	1.48	666	526.5	998.41	1,001.13			985.84	65
	2:35			410.4						
	2:45	1.56	701	311	998.41	1,001.13			985.84	65
	3:00	1.59	715	298	998.41	1,001.13			985.84	65
	3:25				998.41	1,001.13	1,005.48		985.84	65
	3:27			261.5				1,005.57		
	4:10	1.645	740		998.41	1,001.13			985.84	65
11/30/51	9:30 A.M.	1.93	868		992.63	1,001.13			985.84	65
	9:45						1,005.48			
	9:55			185				1,005.56		
	12:35 P.M.	1.93	868	175.5	992.63	1,001.13			985.84	65
	1:50(2)	1.93	868	175.5	992.63	1,001.13	1,005.56			
	2:59						1,005.66			
	3:05							1,005.75		

(1) Well opened; only well flowing except small leak in -26G1.
(2) Well shut off.
* Nonflowing wells with automatic water-level recorders attached.
GPM means gallons per minute.

Table 2.- Flow Capacity Tests - Well 13/25-30Q1

Measurements made with a 30-inch rectangular weir having end contractions; altitude of land surface at well = 835.55 ft; altitude of discharge = 834.37 ft; altitude of initial pressure head in well = 1,000.72 feet. Temperature of water at well = 80.5°F.

Date		Well discharge		Altitude of pressure head (in feet)					Leak, in GPM	
				Observation wells			Leaking wells			
Day	Hour	Cu.ft/sec	GPM	13/24-36Q1	*13/24-26Q1	*13/24-27R1	13/24-25R1	13/24-26Q1	13/24-25R1	13/24-26Q1
11/30/51	3:00 P.M.(1)									
	3:02	2.518	1,133							
	3:09	2.149	967							
	3:10	2.113	951							
	3:13						968.80		647	
	3:17			1,001.13						
	3:48	2.077	935					985.94		65
	4:00	2.041	919	1,001.13			968.70		647	
12/1/51	9:50 A.M.	2.041	919	1,001.13						
	10:21				1,005.20			985.94		65
	10:28					1,005.31				
	10:45							976.24(1)		94.7
	11:15	2.041	919				967.4	986.74(2)	647	65
	11:40	2.041	919							
	1:00 P.M.			1,000.13			967.9	986.74	647	65
	1:39					1,005.20				
	3:07(2)	2.041	919							
	3:40			1,000.13		1,005.10		986.74	647	65
	3:55				1,005.10					

(1) Well opened; only well flowing except leak from -25R1 and small leak from -26Q1.
(2) Well shut off.
* Nonflowing wells with automatic water-level recorders attached.
GPM mean gallons per minute.

Table 2.- Flow Capacity Tests - Well 13/24-26G1

Measurements made with an 18-inch rectangular weir having end contractions; altitude of land surface at well = 972.24 ft; altitude of discharge = 974.91 ft; altitude of initial pressure head in well = 986.7 ft. Temperature of water at well = 68°F.

Date		Well discharge		Altitude of pressure head (in feet)					
				Observation wells				Leaking well	
Day	Hour	Cu.ft/sec	GPM	13/24-36D1	13/25-30C1	*13/24-36M1	*13/24-27K1	13/24-25E1	Leak, in GPM
12/1/51	3:40 P.M.			1,000.1	990.3		1,005.10	967.8	647
	3:48	0.279	126						
	3:55	.279	126			1,005.10			
12/3/51	10:25 A.M.	.279	126	1,001.1	992.6	1,005.61	1,005.70	967.9	647

Well 13/24-26G1 continued flowing as part of 48-hour test; only well flowing except leak from -25E1.

(1) Well opened.

* Nonflowing wells with automatic water-level recorders attached.

GPM means gallons per minute.

Table 2.- Flow Capacity Tests - All Wells Flowing Simultaneously

Altitude of initial pressure head in the following wells:
13/25-30Q1 = 992.63 ft 13/24-26Q1 = 986.74 ft
13/24-36Q1 = 1,001.13 ft 13/24-25K1 = 967.90 ft

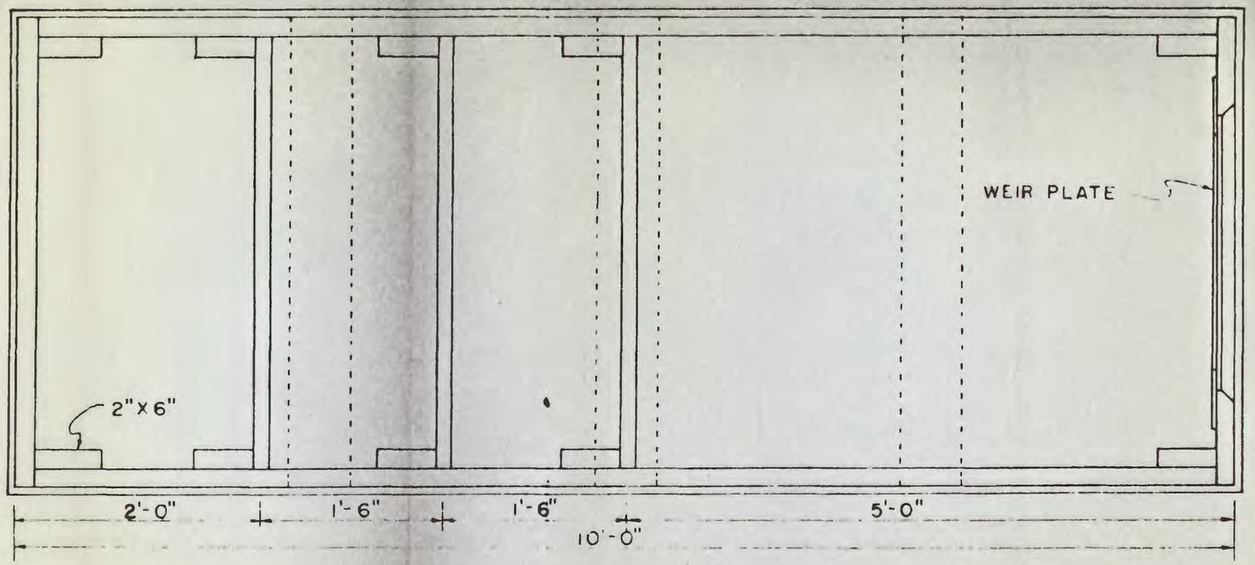
Date		Well discharge								Leak	Water level in observation wells	
		13/25-30Q1		13/24-36Q1		13/24-26Q1		13/24-25K1		13/24-25K1	*13/24-26Q1	*13/24-27K1
Day	Hour	Cu.ft/sec	GPM	Cu.ft/sec	GPM	Cu.ft/sec	GPM	Cu.ft/sec	GPM	GPM	Altitude in ft	Altitude in ft
12/3/51	9:56 A.M.											1,005.70
	10:07										1,005.61	
	10:25					0.279	126					
	10:38							0(1)	0	647		
	10:39							1.645	740	647		
	10:47			0(1)	0							
	10:51			.858	386							
	11:00	0(1)	0									
	11:01	2.555	1,150									
	11:02	2.369	1,066									
	11:04	2.258	1,016									
	11:05	2.214	996									
	11:40	2.113	951									
	12:00 P.M.			.858				1.645	740	262		
	12:15							1.645	740	262		
	12:25					.273	123					
	3:30					.268	121					
12/4/51	9:20 A.M.	2.041	919	.858	386	.262	118					
	9:45										1,004.38	
	10:15											1,004.55
	10:30							1.930	869	205		
	3:00 P.M.			.858	386			1.930	869	180		
	3:20										1,004.45	
	3:28											1,004.71
	3:50	2.041	919			.262	118					
12/5/51	9:10 A.M.	2.041	919									
	9:17			.836	376							
	9:25							1.930	869	177		
	9:38					.262	118					
	9:49										1,003.66	
	9:56											1,003.81
	2:15 P.M.										1,003.49	
	2:28					.256(2)	115					
	2:40							1.930(2)	869	117		
	2:50			.836(2)	376							
	3:00	2.006(2)	903									

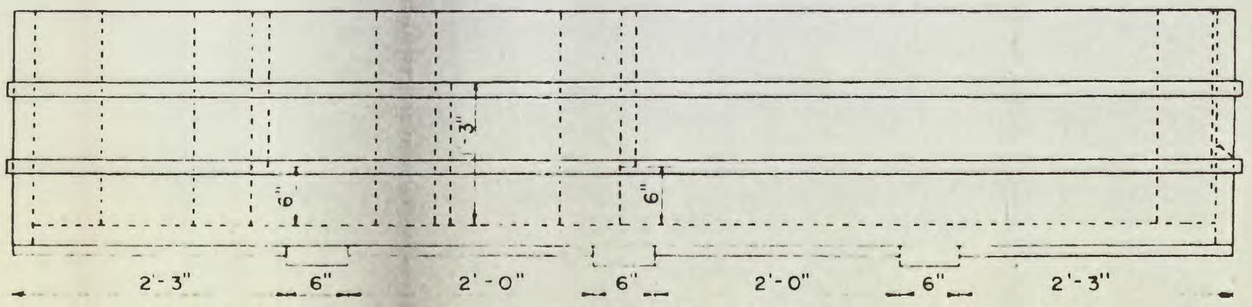
(1) Well opened.
(2) Well shut off.
* Nonflowing wells with automatic water-level recorders attached.
GPM means gallons per minute

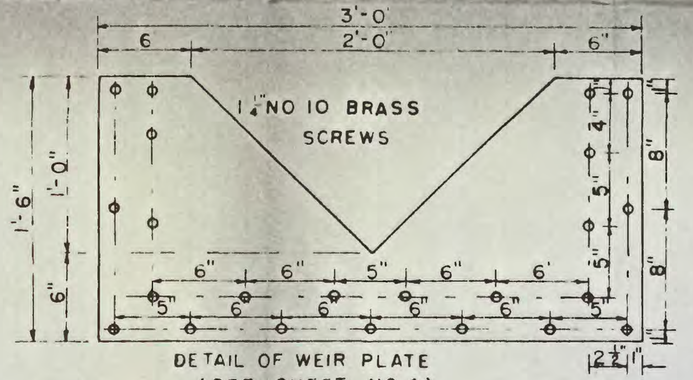
Unpublished records subject to revision


UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
MAP OF THE UPPER COLD CREEK VALLEY
AND THE SURROUNDING AREA
STATE OF WASHINGTON
REPRESENTED BY THE
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
PLATE I
GRANT CO
RIVER
CHINA BAR
New York Ranch
RICHMOND FERRY
Emerson Nipple
Cold Creek
COLD CREEK VALLEY
BLACK ROCK VALLEY
BOUNDARY LINE
Horsethief Point
Cold Creek
T. 13 N.
T. 12 N.
R. 23 E.
R. 24 E.
Scale
Miles
Yards
Feet
Kilometers
Contour interval 25 feet
Datum is mean sea level
WASH
PRIEST RAPIDS
WASH
COYOTE RAPIDS
CHICAGO
Black Rock Spring

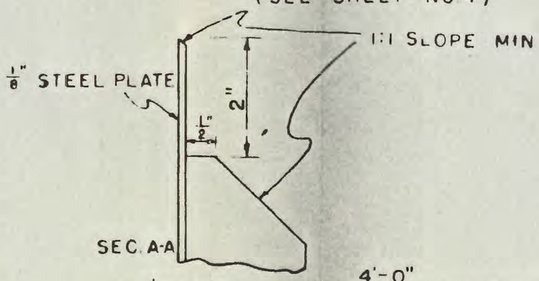
U.S. DEPT OF THE INTERIOR
GEOLOGICAL SURVEY
GROUND WATER BRANCH
PORTLAND, OREGON



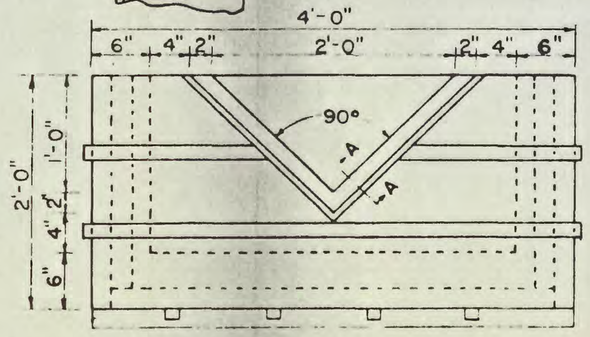




DETAIL OF WEIR PLATE
(SEE SHEET NO 4)



WEIR BOX CONSTRUCTED
OF 2" MATERIAL
ALL SEAMS CAULKED WITH
TAR AND COVERED WITH
1½" X ¾" BATTENS AS SHOWN

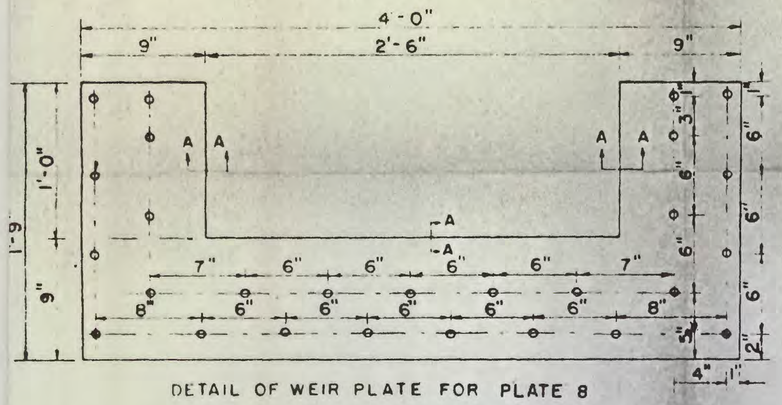


TITLE: 90° V-NOTCH THIN-EDGE WEIR
SCALE: 1" = 1'

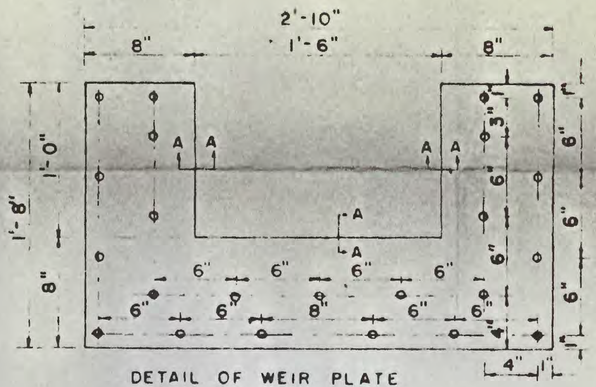
CONSTRUCT ONE (1) WEIR BOX

PT OF THE INTERIOR
OLOGICAL SURVEY
D WATER BRANCH
RTLAND, OREGON

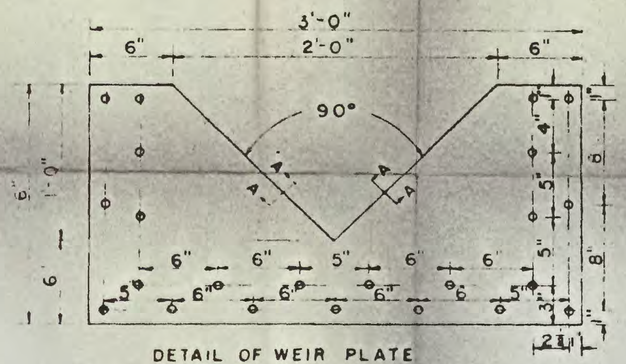
PLATE 11



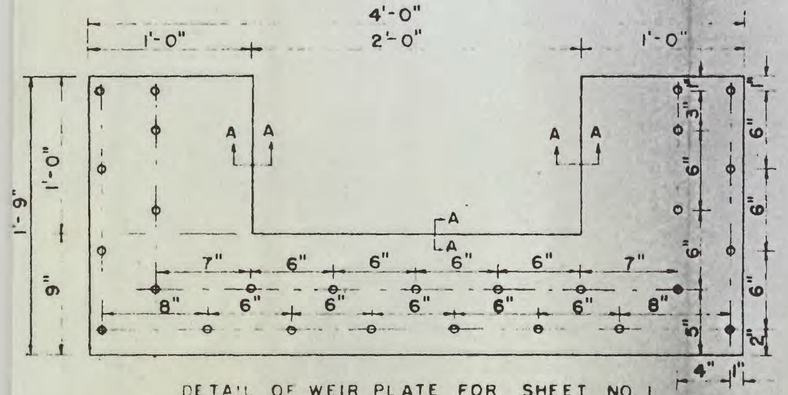
DETAIL OF WEIR PLATE FOR PLATE 8



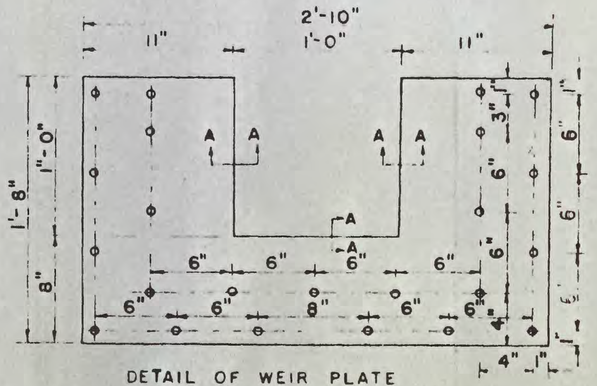
DETAIL OF WEIR PLATE
FOR PLATE 9



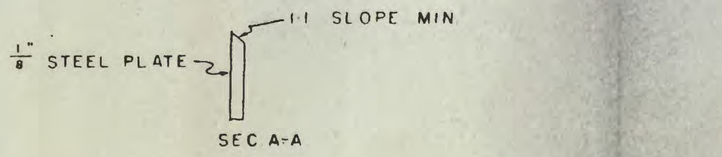
DETAIL OF WEIR PLATE
FOR PLATE 10



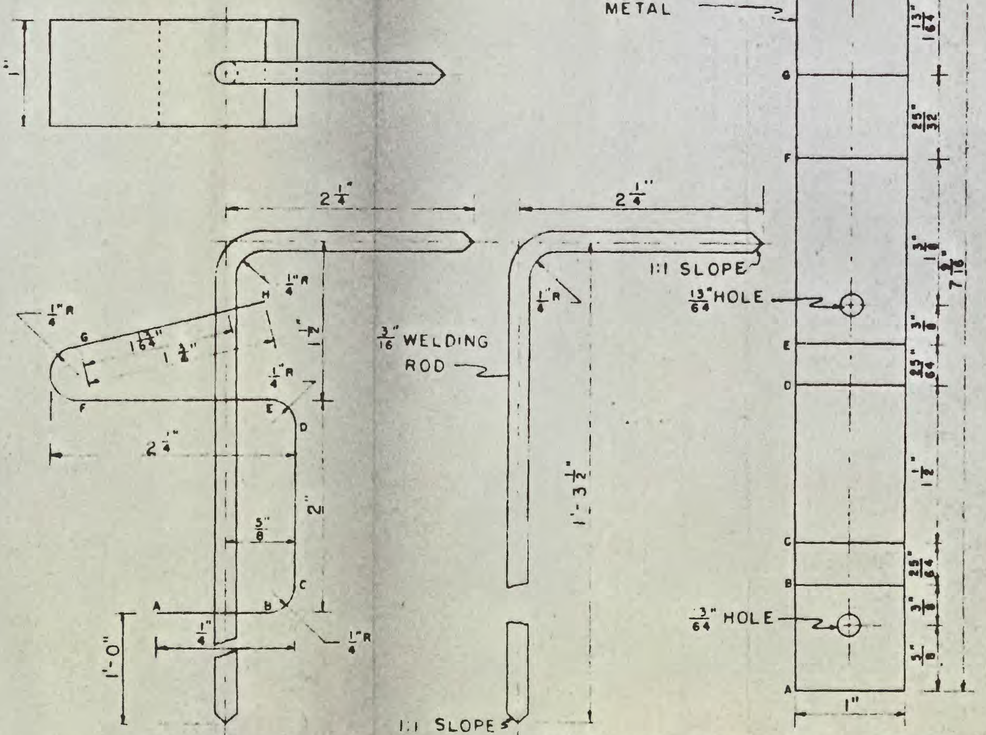
DETAIL OF WEIR PLATE FOR SHEET NO. 1



DETAIL OF WEIR PLATE
FOR PLATE 9



TITLE: WEIR PLATES — MAKE ONE (1) OF EACH
SCALE: 1 1/2" = 1'
USE NO 7 DRILL FOR ALL HOLES



TITLE: HOOK GAGE — MAKE FIVE (5)
SCALE FULL SIZE

SHEET 4 OF 4

PLATE 4


U.S. DEPT OF THE INTERIOR
GEOLOGICAL SURVEY
GRAPH SHOWING FLUCTUATIONS OF WATER LEVEL IN THE BROWN WELL (13/24-28M1) PART OF WHICH RESULTS FROM REGULATION OF NEARBY FLOWING ARTESIAN WELLS.
WATER LEVEL, IN FEET BELOW LAND SURFACE
RECORDER STARTED
RECORDER STOPPED
TRACING COMPILED FROM ORIGINAL RECORDER CHARTS
WATER RESOURCES
PORTLAND,

U. S. DEPT. OF THE INTERIOR
GEOLOGICAL SURVEY

PLATE 5

GRAPH SHOWING FLUCTUATIONS OF WATER LEVEL IN LEMORE WELL (13/24-27K1) PART OF WHICH RESULTS FROM REGULATION OF NEAR-BY ARTESIAN WELLS.

WATER LEVEL IN FEET BELOW LAND SURFACE

ATMOSPHERIC PRESSURE

WATER LEVEL IN WELL 13/24-27K1

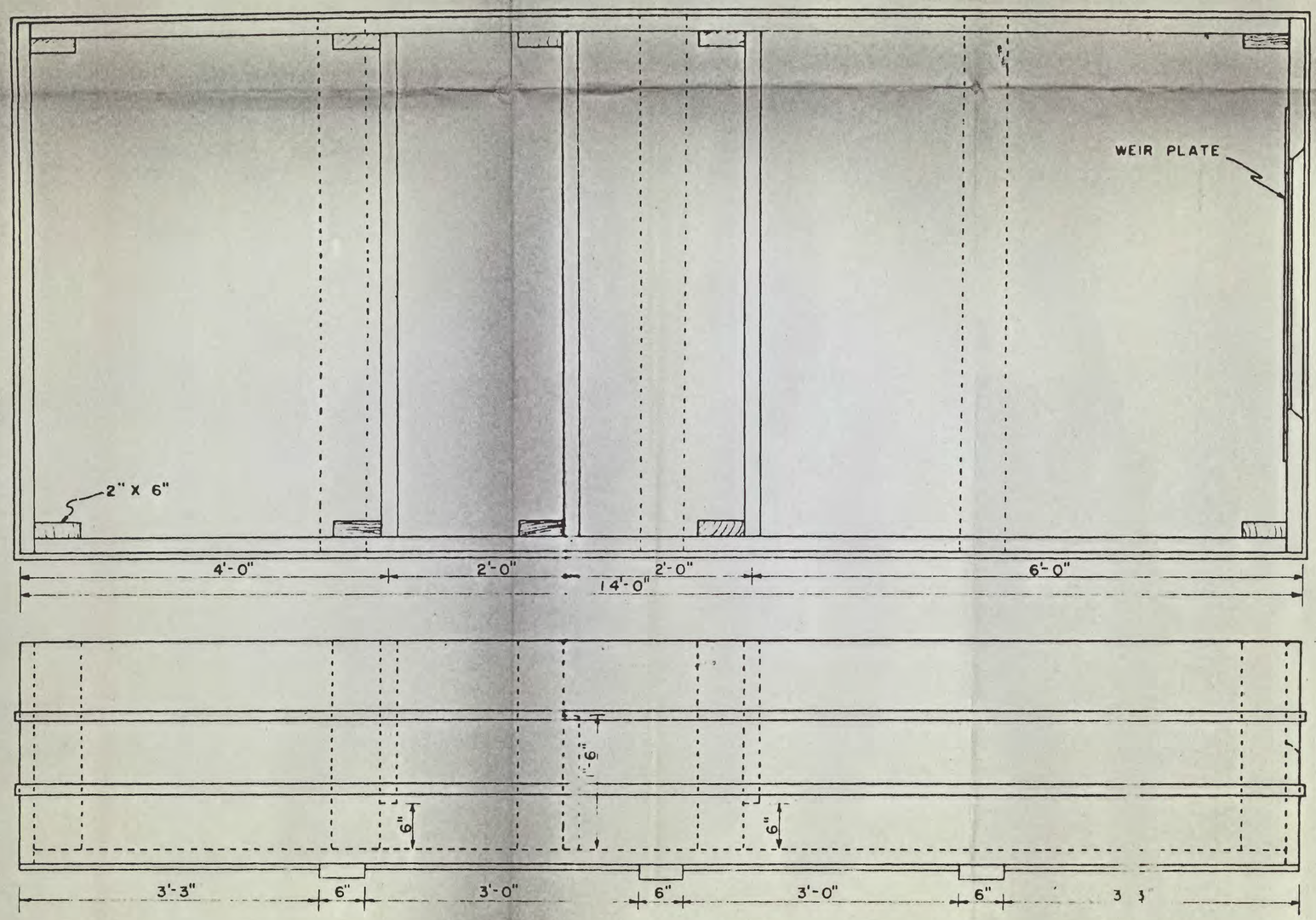
TRACING COMPILED FROM ORIGINAL RECORDER CHARTS.
D.G. HART

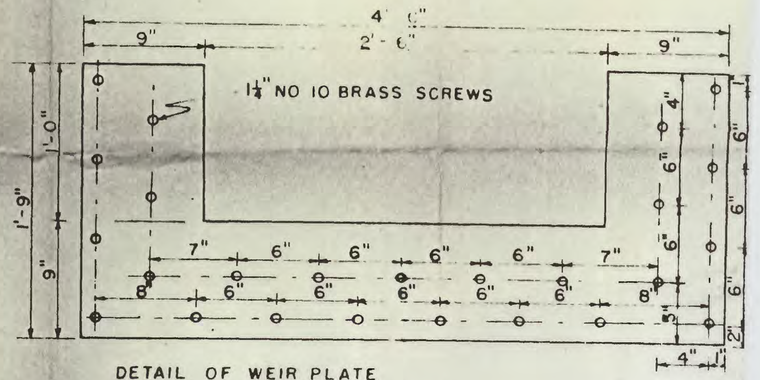
WATER RESOURCES DIVISION
GROUND WATER BRANCH
MENLO PARK, CALIFORNIA

58-46

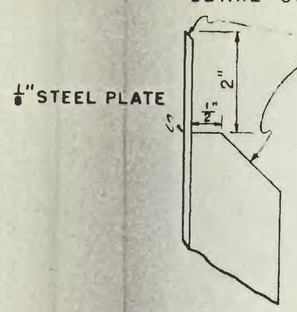
PLATE 8

S DEPT. OF THE INTERIOR
GEOLOGICAL SURVEY
ROUND WATER BRANCH
PORTLAND, OREGON



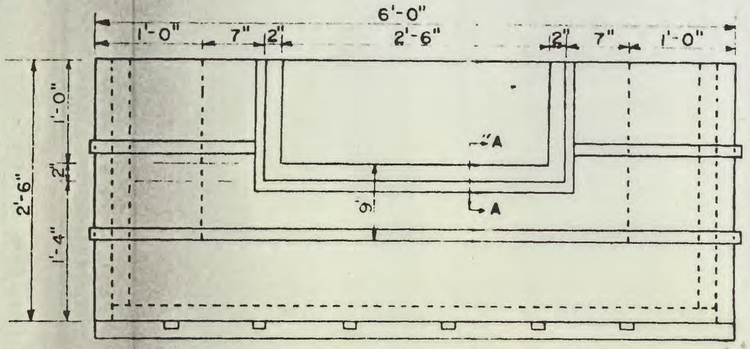


DETAIL OF WEIR PLATE
(SEE SHEET NO. 4)



SEC. A-A

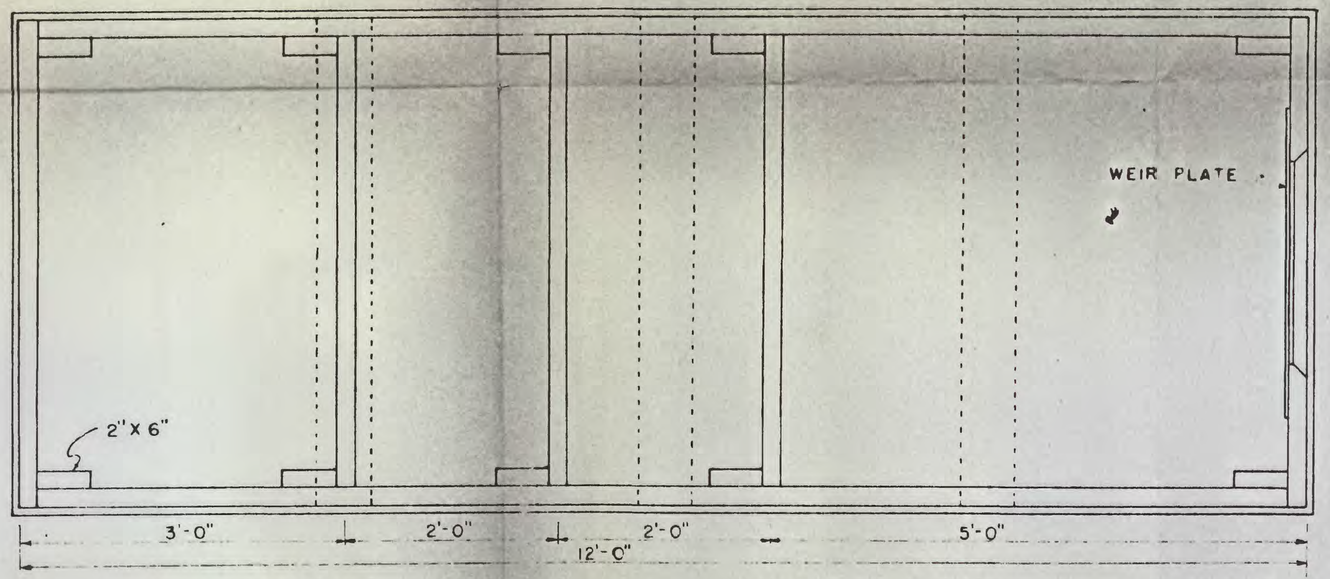
WEIR BOX CONSTRUCTED OF
2" MATERIAL
ALL SEAMS CAULKED WITH TAR
AND COVERED WITH 1½" X ¾" BATTEN

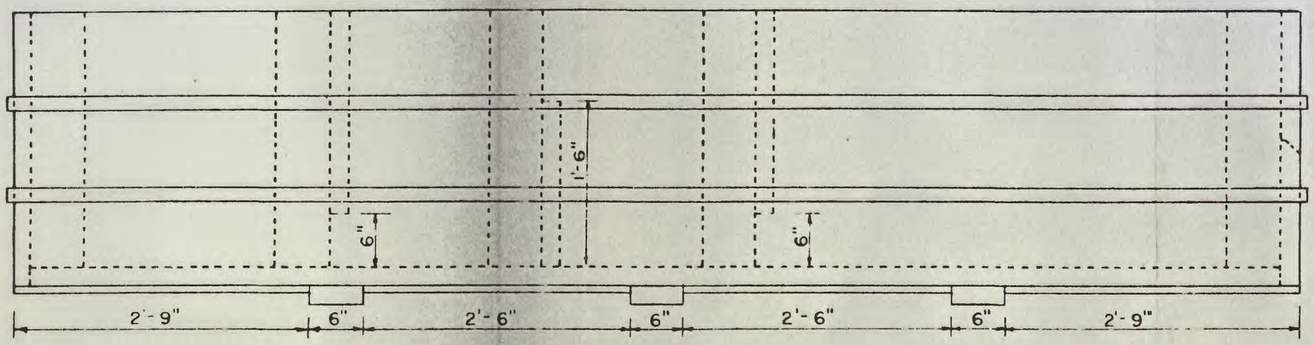


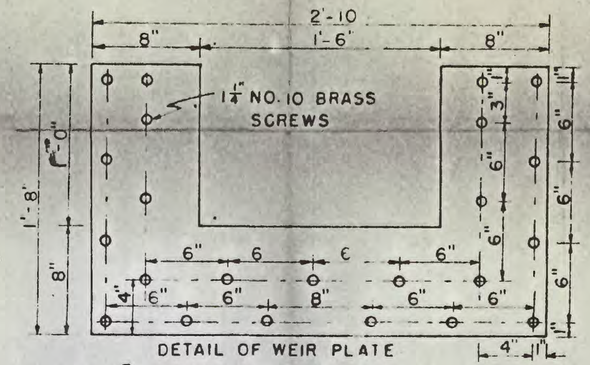
TITLE: CONTRACTED THIN-EDGE WEIR
SCALE: 1" = 1'
CONSTRUCT TWO (2)
WEIR BOXES

SHEET 1 OF 4

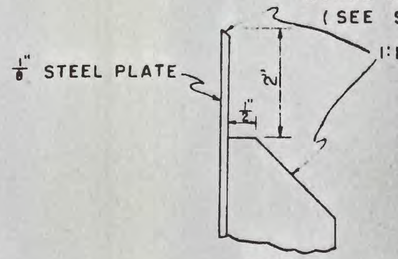
U.S. DEPT. OF THE INTERIOR
GEOLOGICAL SURVEY
GROUND WATER BRANCH
PORTLAND, OREGON





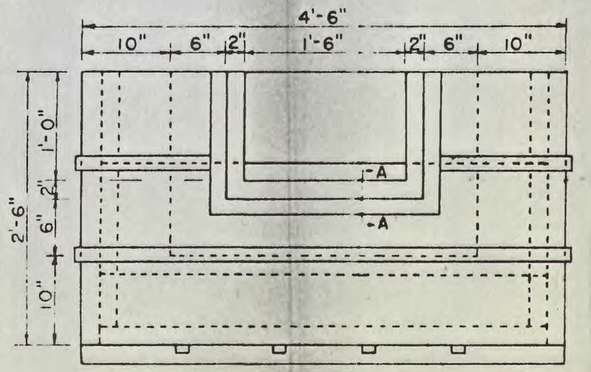


DETAIL OF WEIR PLATE
(SEE SHEET NO 4)



SEC. A-A

WEIR BOX CONSTRUCTED OF 2" MATERIAL
ALL SEAMS CAULKED WITH TAR AND COVERED WITH 1½" X ¾" BATTENS AS SHOWN



TITLE: CONTRACTED THIN-EDGE WEIR
SCALE: 1"=1'
CONSTRUCT TWO (2) WEIR BOXES