WATER MEASUREMENT

This chapter of the Irrigation Guide is used to provide charts for the various measuring devices that are specifically available to SCS field offices in New Mexico.

These devices are:

1. Orifice Plates
2. Parshall Flumes
3. Rectangular Weirs
4. V-Notch Weirs
5. Portable Water Meters
6. Permanently Mounted State Engineer Water Meters (Roswell Artesian Basin Only)
7. Pipe Flow Discharge

8. Float Method of Ditch Flow Measurement

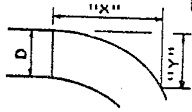
9. Siphon Tube Discharge

10. Headgate Discharge

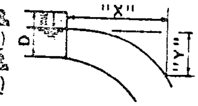
11. Sprinkler Nozzle Discharge

All of the above methods of flow measurements have a corresponding chart in this chapter. For further information on flow measurements consult Chapter 9, Section 15 of the National Engineering Handbook; or the attached Bulletin No. 552, "Water Measurement," Idaho Cooperative Extension Service.

ESTIMATED FLOWS FROM PIPES

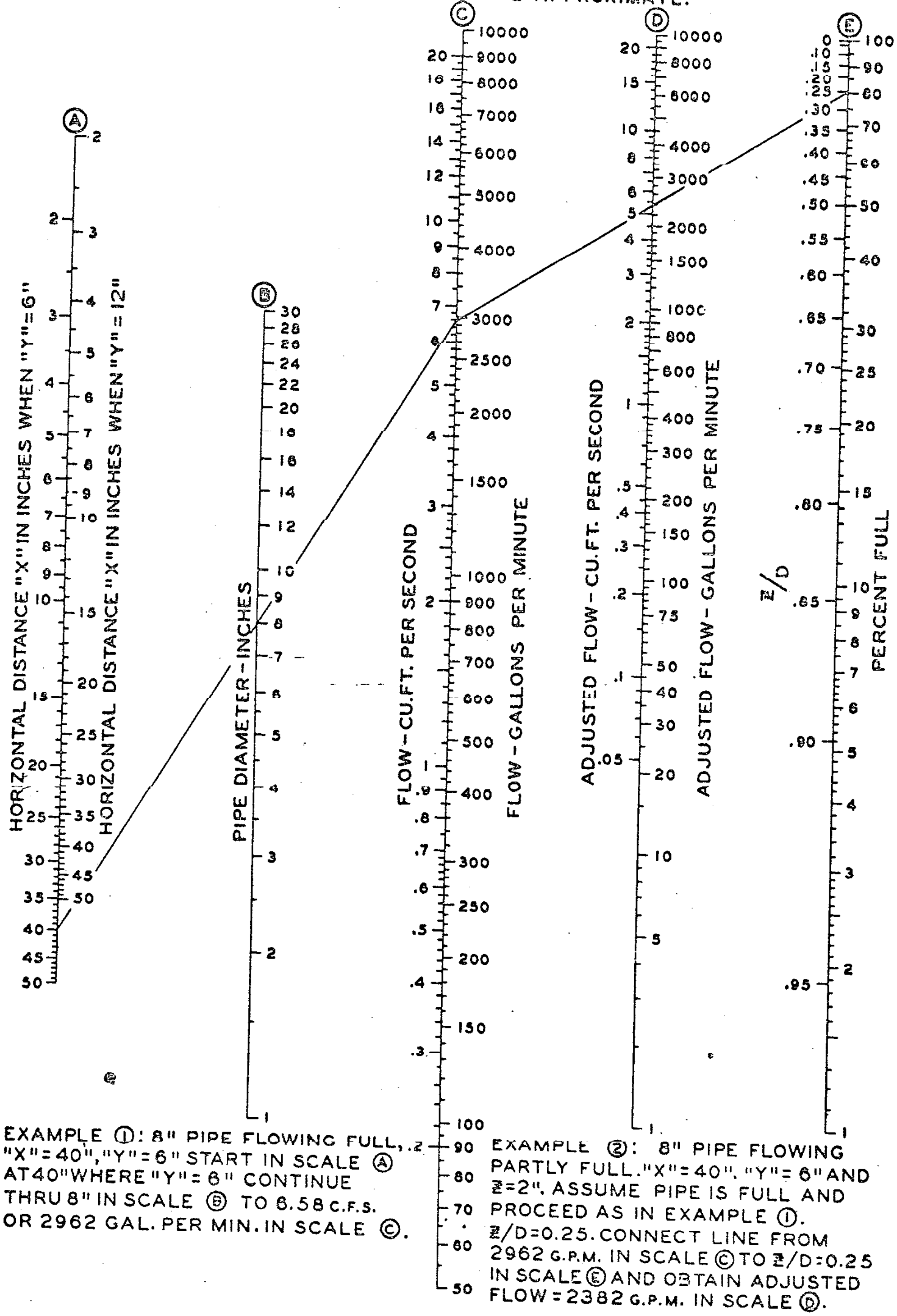


WHEN PIPE IS FULL & Y=6", Q=1.157D²X (G.P.M.)
WHEN PIPE IS FULL & Y=12", Q=0.618D²X (G.P.M.)



WHEN PIPE IS PARTLY FULL, ASSUME PIPE FULL, COMPUTE Ƶ/D AND OBTAIN ADJUSTED Q FROM SCALE Ⓓ

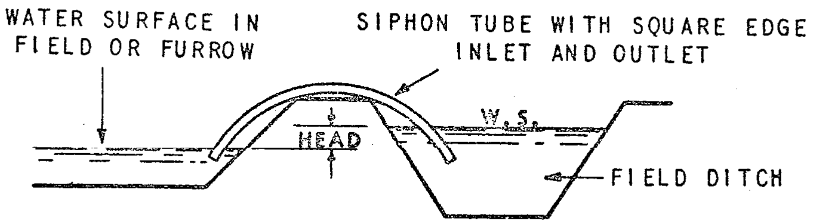
USE EITHER FOLDING RULE OR TEMPLATE WITH "Y"=TO 6" OR 12".
FOR SLIGHTLY INCLINED PIPES, MEASURE "X" PARALLEL TO PIPE & "Y" VERTICALLY.
RESULTS OBTAINED FROM THIS SOLUTION ARE APPROXIMATE.



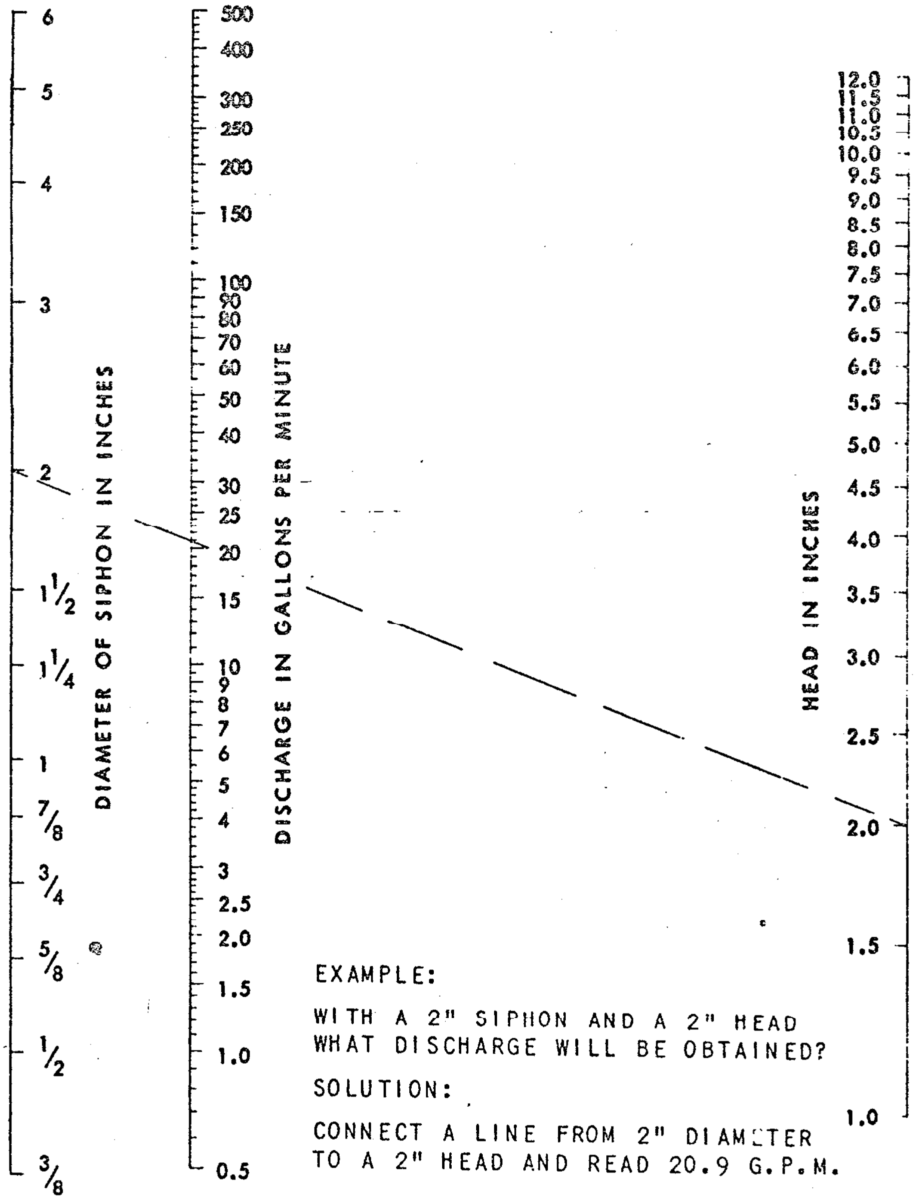
EXAMPLE ①: 8" PIPE FLOWING FULL, "X"=40", "Y"=6" START IN SCALE Ⓐ AT 40" WHERE "Y"=6" CONTINUE THRU 8" IN SCALE Ⓑ TO 6.58 C.F.S. OR 2962 GAL. PER MIN. IN SCALE Ⓒ.

EXAMPLE ②: 8" PIPE FLOWING PARTLY FULL. "X"=40", "Y"=6" AND Ƶ=2". ASSUME PIPE IS FULL AND PROCEED AS IN EXAMPLE ①. Ƶ/D=0.25. CONNECT LINE FROM 2962 G.P.M. IN SCALE Ⓒ TO Ƶ/D=0.25 IN SCALE Ⓔ AND OBTAIN ADJUSTED FLOW=2382 G.P.M. IN SCALE Ⓓ.

SIPHON DISCHARGE



$$Q = 0.65 \times A \times \sqrt{2gh}$$



EXAMPLE:

WITH A 2" SIPHON AND A 2" HEAD WHAT DISCHARGE WILL BE OBTAINED?

SOLUTION:

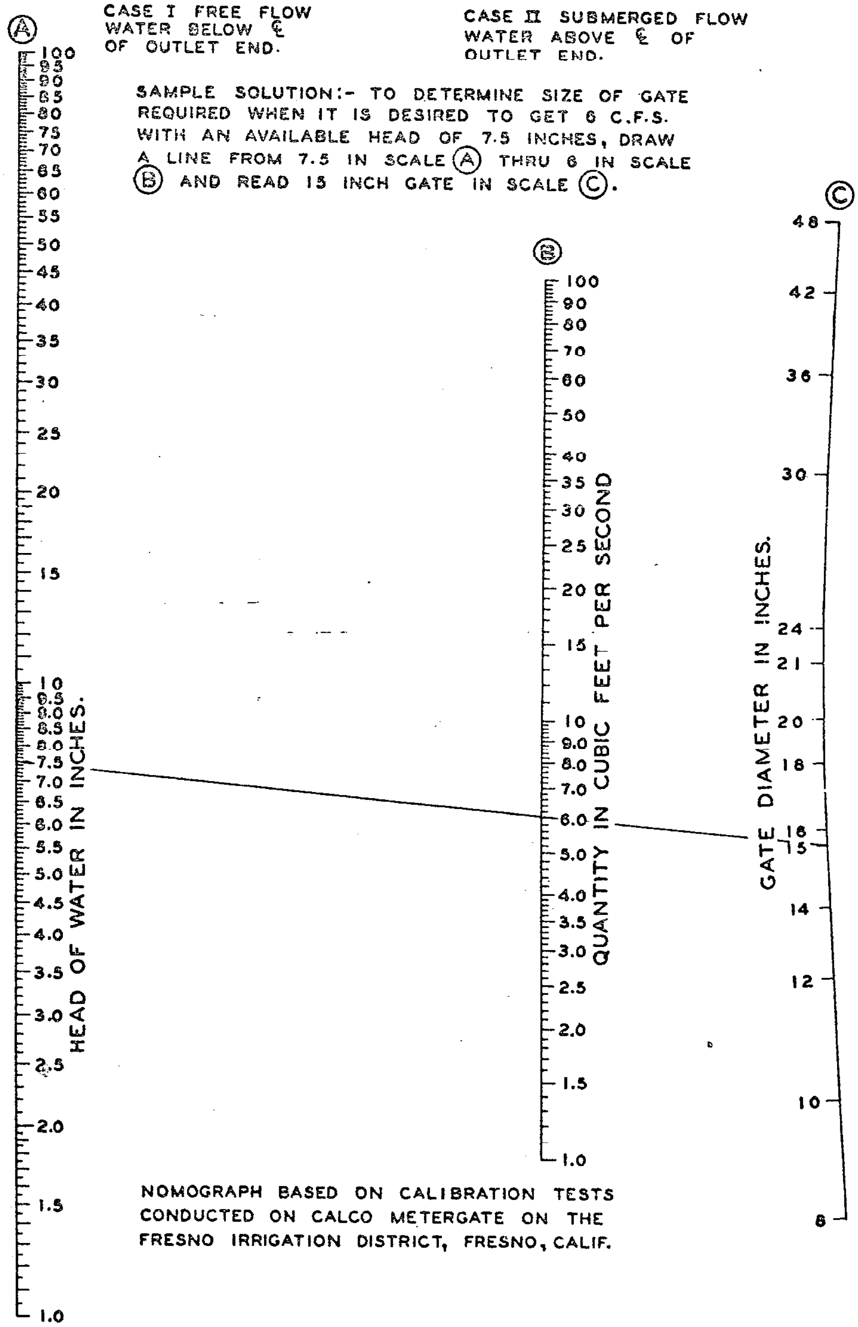
CONNECT A LINE FROM 2" DIAMETER TO A 2" HEAD AND READ 20.9 G.P.M.

APPROXIMATE FLOW THROUGH PIPE TURNOUT STRUCTURES

BASED ON 2 FT. LENGTH OF PIPE ATTACHED TO GATE
FOR 10 FT. OF PIPE ADD 3 INCHES TO REQUIRED HEAD

NOTE:- HEAD OF WATER ON GATE TO BE MEASURED BY EITHER OF TWO FOLLOWING METHODS.

SAMPLE SOLUTION:- TO DETERMINE SIZE OF GATE REQUIRED WHEN IT IS DESIRED TO GET 6 C.F.S. WITH AN AVAILABLE HEAD OF 7.5 INCHES, DRAW A LINE FROM 7.5 IN SCALE (A) THRU 6 IN SCALE (B) AND READ 15 INCH GATE IN SCALE (C).



NOMOGRAPH BASED ON CALIBRATION TESTS CONDUCTED ON CALCO METERGATE ON THE FRESNO IRRIGATION DISTRICT, FRESNO, CALIF.

DISCHARGE THROUGH SMALL PARSHALL FLUMES

Free-flow Conditions

Head H_a in inches	Discharge g.p.m. 1"	Discharge g.p.m. 2"	Head H_a in inches	Discharge g.p.m. 1"	Discharge g.p.m. 2"
1/2	0.9	1.9			
9/16	1.1	2.2	2-9/16	15.1	27.0
5/8	1.3	2.4	2-5/8	15.8	27.9
11/16	1.6	2.7	2-11/16	16.4	28.8
3/4	1.8	3.2	2-3/4	16.9	29.7
13/16	2.1	3.6	2-13/16	17.6	30.6
7/8	2.5	4.1	2-7/8	18.2	31.5
15/16	2.8	4.5	2-15/16	18.9	32.5
1	3.2	5.0	3	19.6	33.4
1-1/16	3.6	5.7	3-1/16	20.2	34.4
1-1/8	4.1	6.3	3-1/8	20.7	35.3
1-3/16	4.5	7.0	3-3/16	21.4	36.3
1-1/4	4.8	7.7	3-1/4	22.1	37.4
1-5/16	5.2	8.4	3-5/16	22.8	38.3
1-3/8	5.6	9.2	3-3/8	23.4	39.2
1-7/16	6.0	10.2	3-7/16	24.1	40.3
1-1/2	6.3	10.9	3-1/2	24.8	41.5
1-9/16	6.7	12.1	3-9/16	25.3	42.8
1-5/8	7.2	12.9	3-5/8	25.9	44.1
1-11/16	7.6	13.9	3-11/16	26.6	45.6
1-3/4	8.1	14.9	3-3/4	27.3	47.1
1-13/16	8.5	15.8	3-13/16	28.0	48.7
1-7/8	9.0	16.7	3-7/8	28.6	50.3
1-15/16	9.5	17.5	3-15/16	29.1	51.9
2	10.1	18.7	4	30.1	54.0
2-1/16	10.7	19.8	4-1/16	30.8	56.3
2-1/8	11.3	20.7	4-1/8	31.5	58.5
2-3/16	11.8	21.6	4-3/16	32.6	60.8
2-1/4	12.3	22.5	4-1/4	33.7	63.0
2-5/16	12.8	23.4	4-5/16	34.9	65.3
2-3/8	13.3	24.3	4-3/8	36.0	67.5
2-7/16	13.8	25.2	4-7/16	36.9	69.8
2-1/2	14.4	26.1	4-1/2	37.8	72.0

USE OF FLOW METERS

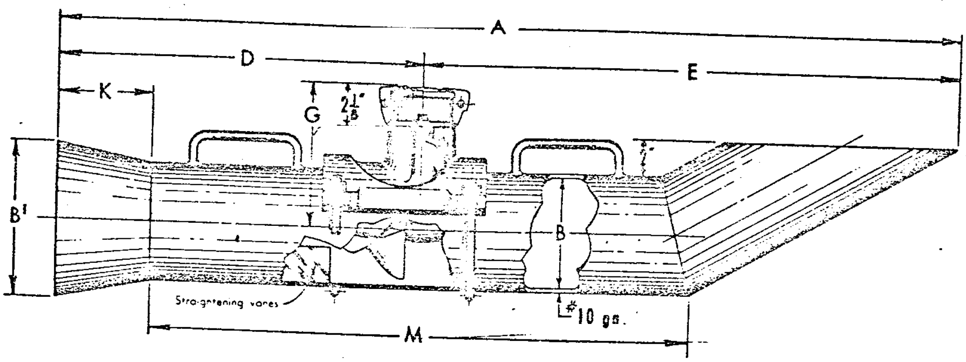
Low pressure flow meters such as the portable meter shown are very accurate and will record both instantaneous flow (GPM) and total gallons pumped.

This meter can be used to accurately test turbine pumps for wire to water efficiency or to determine yield - draw down relations for a new well test.

For accurate measurement, place portable meter tube in a horizontal position and of sufficient depth to provide a full flow of water in the tube, locate where no obstruction directly ahead might cause a spiralling flow into the meter.

Materials regularly used are aluminum alloys, copper base alloys, stainless steel and plastic. Plain steel meter and U-bolts are standard, but protective coated tubes and stainless steel U-bolts are available. These meters are resistant to normal water corrosion but are not guaranteed against chemical or electrolytic action.

Propellers may be stored in air temperatures up to 175° F. or used in water up to 100° F. without damage.



SIZE	A	B	B[1]	D	E	G	K	M	Tot. Wgt.	Normal Flow Range G. P. M.
4	37 3/4	4	6	13 1/4	24 1/2	7 5/8	4	23	35	60/400
6	48 1/4	6	8	19 1/2	28 3/4	7 3/4	5	29	50	100/900
8	54 1/4	8	10 ½	22	32 1/4	9 1/4	6	31	70	120/1200
10	66 1/4	10	13	27 1/8	39 1/8	9 1/4	8	37	100	160/1500
12	76 3/4	12	16	33 1/8	43 5/8	11 1/4	10	42	125	200/2000
14	88 1/4	14	18 ½	39 1/8	49 1/8	11 1/4	12	48	165	250/2500

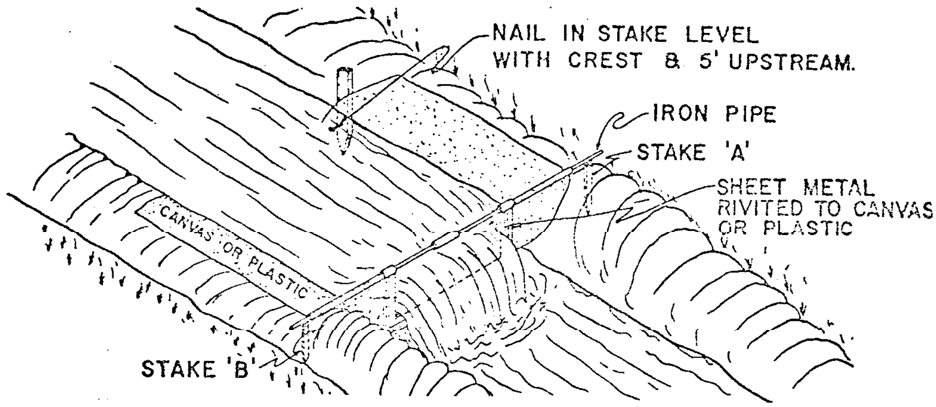
"Master Flo" Portable Flow Meter Design to Measure Pump Discharge Accurately

(Courtesy - Master Flo Meter Company, El Monte, California)

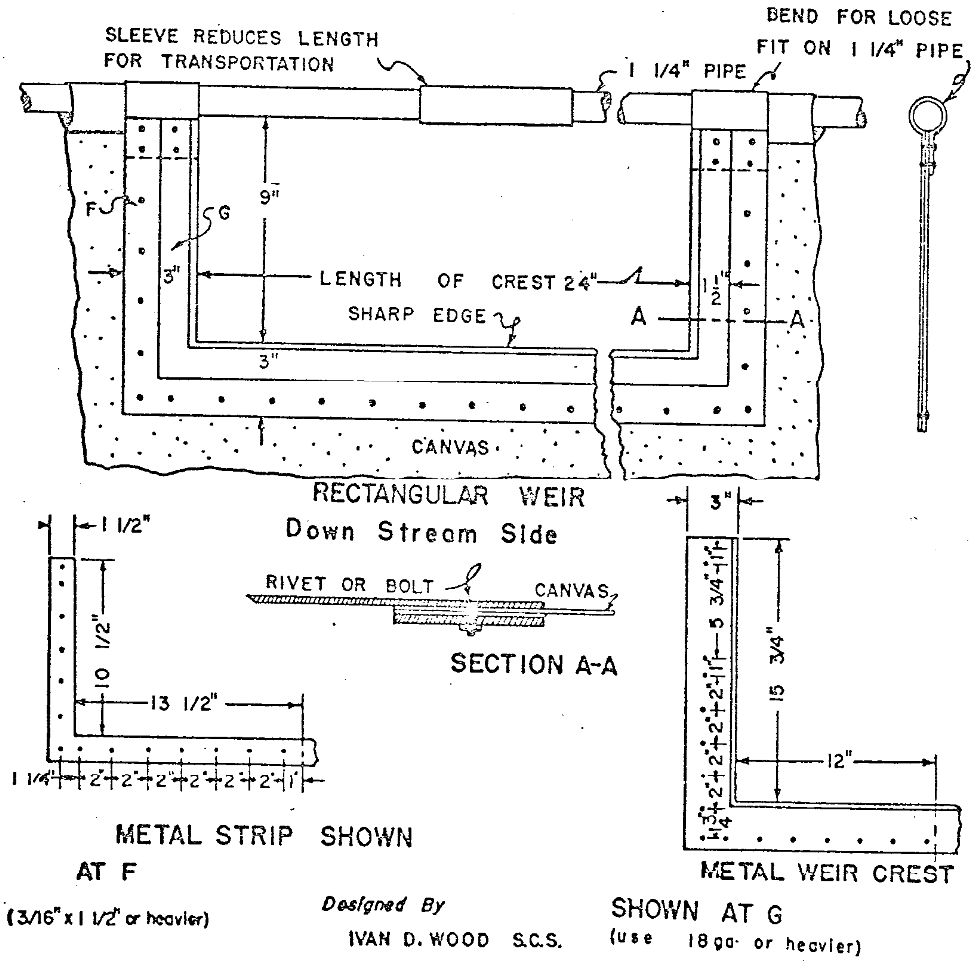
CONVERSION TABLE FOR WATER METER READINGS
IN ROSWELL ARTESIAN BASIN - METER CONSTANT = .001

Meter Rev/Min	GPM
.1	32.4
.2	65
.4	130
.6	194
.8	259
1.0	324
1.2	388
1.4	453
1.6	518
1.8	583
2.0	648
2.2	713
2.4	778
2.6	842
2.8	907
3.0	972
3.2	1036
3.4	1102
3.6	1166
3.8	1231
4.0	1296

NOTE: For meter constant of .01, multiply GPM values by 10.



Installation of Portable Rectangular Weir made from plastic or canvas and sheet metal.



Details of Easy to Construct Portable Rectangular made from plastic or canvas and sheet metal.

ESTIMATING RATES OF FLOW

In cases where rates of flow are not known, it may be necessary to rely on estimates. Measurements of some kind usually are needed. Some of the most useable estimating procedures are discussed below.

Float Method:

The cross sectional area can be determined by direct measurement of channel dimensions. The velocity can be estimated by timing the passage of a small float through a measured length of channel. The procedure for estimating rate of flow by the float method is as follows:

1. Select a straight section of ditch with fairly uniform cross sections. The length of the section will depend on the current, but one hundred feet usually will be adequate. A shorter length may be satisfactory for slow flowing ditches.

2. Make several measurements of depth and width within the trial section, to arrive at the average cross section area. The area should be expressed in terms of square feet.

3. Place a small float in the ditch a few feet upstream from the upper end of the trial section. Determine the number of seconds it takes for the float to travel from the upper end of the trial section to the lower end. Make several trials to get the average time of travel. The best floats are small rounded objects which float nearly submerged. They are less apt to be affected by wind or to be slowed by striking the side of the channel. Among small objects which make good floats are a long necked bottle partly filled with water and capped, a rounded block of wood, or an orange. A wooden sphere like a croquet ball is excellent.

4. Determine the velocity (or speed) of the float in units of feet per second by dividing the length of the section (in feet) by the time (in seconds) required for the float to travel that distance.

5. Determine the average velocity of the stream. Since the velocity of the float on the surface of the water will be greater than the average velocity of the stream, the float velocity must be multiplied by a correction coefficient to obtain a good estimate of the true average stream velocity. The correction factor varies with the type of float used and with the shape and uniformity of the channel. With floats which sink only an inch or two below the water surface, a coefficient of about 0.80 should be used for most unlined farm ditches. A coefficient of 0.85 is appropriate for smooth uniform lined ditches. With floats that extend two-thirds or more of the water depth below the surface, the coefficients should be about 0.85 for unlined ditches and 0.90 for lined ditches.