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STATE COLLEGE OF WASHINGTON
PULLMAN, WASHINGTON

DEPARTMENT OF EXTENSION
J. A. TORMEY, Director

How to Measure Water

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ENGINEERING DIVISION
OF THE
EXTENSION DEPARTMENT

Circular No. 1

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INTRODUCTION.

Inquiries come to this office asking for information concerning the measurement of water for irrigation. These queries are from farmers who are anxious to know whether they are getting the amount of water provided for in their contract.

The methods of measuring water are not familiar to them. Farmers are familiar, however, with the process and know when they get true weights for their stock and produce, but the measurement of running water introduces an element of time that gives trouble.

To assist such people and to make it possible for them to know that they are really getting what is due them, the following pages have been written.

No attempt has been made to develop or explain formulae. Technical terms have generally been avoided and common language used. For the scientist, plenty has been written, and the effort now should be to put this knowledge into a working form for those who have daily use for it.

Most contracts in this state provide for the delivery of water from April 1st to Nov. 1st, a period of seven months, or 210 days. The average growing season during which time water is needed for crop production is about four months or 120 days. Consequently, if the water-user gets all the water his contract calls for he should get 1¾ as much as he contracts for continuously during the 120 day period. If not used continuously during that period, then a further increase should be made. If his contract provides for one cubic foot per second for 160 acres, continuous flow, service to begin April 1st and close Nov. 1st, his land would receive 32 acre-inches of water, or the equivalent of 32 inches of rainfall.

If it were used continuously for 120 days only, the land would receive 18¼ acre-inches. As the number of days during which water is used are reduced, the amount used should be proportionally increased. In many instances the amount of water provided for in the contract is in excess of the demands of the crop. The irrigator has a right to all the water he can beneficially use, but not to more than is agreed to in his contract. This bulletin in no way undertakes to discuss the water needs of the various crops; neither does it offer any suggestions as to how to irrigate, or to till the ground so as to conserve the moisture. It only gives information as to how to measure water. Experience has shown that plants need most water during June, July and August; that a continuous flow is not needed, is not economical, and under good practice is not generally used; consequently, the farmers' supply ditches and measuring weirs should be ample in size to carry a large head of water for short periods, so that the water not needed in April, May, September and October may be used during the hot months.

Since our statute does not recognize the miners inch as a unit of measurement in the distribution of water, and since there is no standard miners inch in use in this state, no definition will be attempted.

CUBIC FOOT PER SECOND.

The cubic foot per second and decimals thereof not only provide a legal unit of measure, but one that is uniform the world over and should, therefore, be understood by every one. It is an absolute unit whose quantity cannot be subject to dispute. The state law provides that in appropriating water to ditches the quantity shall be estimated in cubic feet per second.

Further, since the opening through a miners inch measuring box is liable to be clogged by floating weeds and other debris, and since they fail to deliver their full rated quantity, and thereby entail a loss upon the water user, it is generally considered better practice to use a wier which is very much less liable to be choked by debris floating in the canal.

To ascertain the discharge of a stream it is necessary first, to weigh or measure the amount of water passing a certain point each second and multiply that quantity by the number of seconds it is flowing. One cubic foot per second, as is usually provided by contract in this state, means 7½ gallons or one cubic foot for every second of time from April 1st to November 1st.

Instead of scales to weight the quantity of water that passes a given point in a stream each second of time, or of a gallon measure, to measure it with, a weir is used, which accurately measures the amount of water that flows over it each second of time.

We may imagine a trough, flume or ditch leading away from a river, creek, or lake, and a man dipping water from the stream or lake with a bucket holding 7½ gallons and pouring it into the ditch or flume. If he dips up one bucketful every second and pours it into his canal or flume, the stream flowing away to his irrigated field will be one cubic foot per second or "one second-foot." Such a stream of water would cover two acres of land 12 inches deep every 24 hours. In other words, one "second-foot" will cover one acre one inch deep every hour or one acre 24 inches deep in 24 hours. It really supplies one acre-inch per hour. To speak of a "second-foot" (or cubic foot per second), without specifying the time or duration of the flow, gives no definite information as to the quantity of water supplied.

ACRE-FOOT.

The "second-foot" can be used only for running water. It is often convenient in irrigation to describe a certain volume of stored water. For this purpose the acre-foot has been quite generally adopted. This unit represents the quantity of water required to cover one acre one foot deep. Since there are 43,560 square feet in an acre, there are 43,560 cubic feet of water in one acre-foot. The acre-foot is a unit of volume, and does not carry the time element with it.

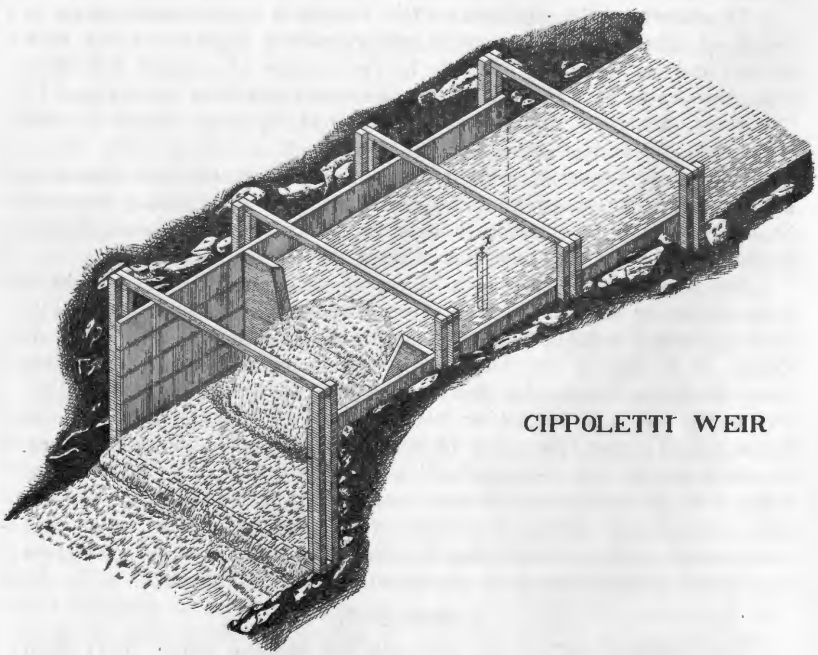
The most accurate and convenient method of measuring small streams is by means of weirs. Both rectangular and trapezoidal or

Cippoletti weirs are in use. The U. S. Department of Agriculture generally uses the Cippoletti weir and, on account of its wide use among irrigators, this form of weir will be described and tables inserted to determine the discharge.

If the conditions set forth in the following pages are complied with the worst results should not contain more than one or two per cent. of error.

Mr. Ryan in Bulletin 6, of the Montana Experiment Station, says: "No device for measuring flowing water has been more thoroughly tested and experimented with than the weir, with the result that, notwithstanding the simplicity of its construction, we may, by taking proper precauions, determine the amount of water flowing over it within one per cent."

To secure accurate measurements the following rules should be observed, both in selecting the size of the weir and in placing the same.



CIPPOLETTI WEIR

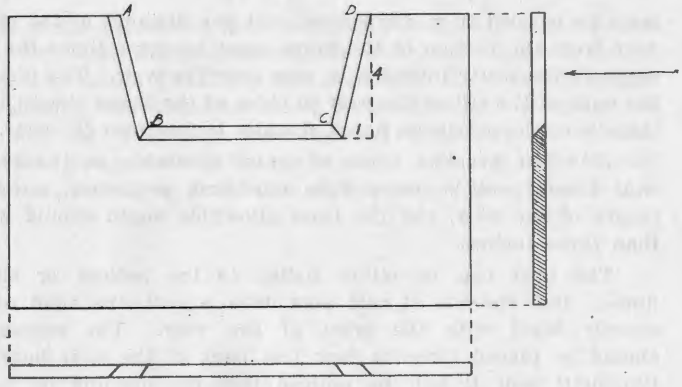


Fig. 2

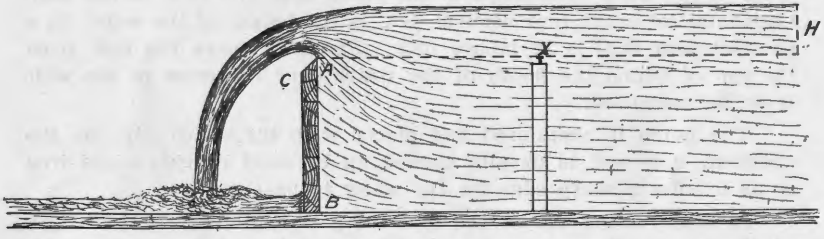


Fig. 3.

MEASURING WEIRS.

Figures 2 and 3 show a trapezodial or Cippoletti weir, the sides having an inclination of one horizontal to four vertical. It is believed that the sketches show the details of construction with sufficient clearness to permit of the proper placing of both weir and post from which the depths are to be measured.

(1) The dimensions of the flume in which the weir is placed will be governed by the volume of water to be measured, but in no case should the length be less than 8 feet nor the width be less than the width on the surface water line of the ditch. The bottom of the flume should be level in both directions. Its upstream end should be placed on grade with the bottom of the ditch so that water will enter without eddies or disturbances. The channel of the ditch should have a uniform grade and cross section for 100 feet upstream from the flume, if possible, and its axis should pass through and parallel to the middle of the structure.

The end and bottom contractions of the weir must be complete. To secure this: (a) The opening in the weir must be in a plane surface perpendicular to the course of the water; (b) the upstream edge

must be beveled to a sharp crest; (c) the distance of the crest of the weir from the bottom of the flume must be three times the maximum depth of the water intended to pass over the weir. The distance from the ends of the sill of the weir to sides of the flume should be not less than twice the maximum depth of water to flow over the weir.

(2) The greatest depth of water allowable on the crest of the weir should not be more than one-third, or better, one-fourth the length of the weir, and the least allowable depth should not be less than three inches.

The post can be either nailed to the bottom or side of the flume. Into the top of said post drive a nail, the head of which is exactly level with the crest of the weir. The measuring post should be placed three to four feet back of the weir board. In the Cippoletti weir it will be noticed that the opening or notch is of regular trapezodial form; that is, the top and bottom are horizontal and the sides slope at an angle of about 14 degrees to the vertical.

Figure 2 shows the notch in detail. The line B C is called the crest of the weir. The slope of the sides, A B and C D, is one inch horizontal for every four vertical, B C is the length of the weir. In a one-foot weir B C is 12 inches long. Figure 3 shows the post from the top of which the depth of the water over the crest of the weir is to be measured.

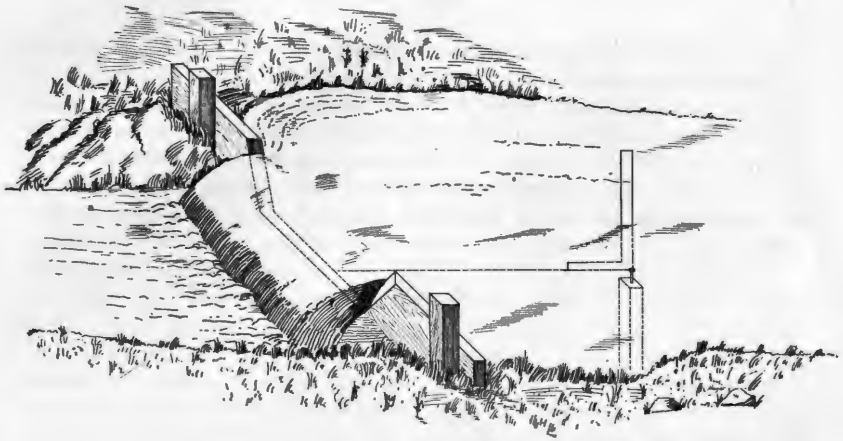
The notch is chamfered and placed with the sharp edge on the upstream side and is usually backed up by steel or galvanized iron so as to offer a sharp edge for the water to pass over.

In constructing a weir the first thing is to determine the length of the crest. Suppose one second-foot is allowed by contract for each 160 acres of land, and the farmer has 40 acres to be watered, then he has a right to 0.25 second-feet, if there is to be a continuous flow of water. If, however, it is to be delivered in good big working heads as suggested in another part of this bulletin, then the crest should be 1½ to 2 feet long.

The intent of the rules is to provide that the cross section of the water in the flume or channel back of the weir shall be seven to eight times greater than the cross section of the water over the crest of the weir. When these conditions obtain the measurements will be satisfactory.

The weir-board may be slid in between a pair of guides while measurements are made, and it may then be moved. This is an excellent plan when there is rubbish, weeds, mud, etc., in the water. By such an arrangement the flume is kept clean and the measurements will be correct. Where a measuring box is filled with mud and rubbish up even with the crest of the weir the discharge is in excess of what it should be and the measurement cannot be relied upon. Sometimes it will be possible by damming up the stream to so widen and deepen its section that a weir can be set without the expense of a flume. This can only be recommended where a temporary measurement is wanted. When such a plan is adopted, the weir should be placed at

right angles to the current of the stream, at a point where the chanel is straight for some distance above the weir, and the current, if any be noticed, should head into the center of the overflow space. The water should be brought as nearly as possible to a state of rest above the weir by artificially widening and deepening the stream. In general the rules governing the placing of a weir in a flume should be observed in placing a weir in a stream where the flume is not used.



The accompanying illustration will assist the beginner in placing a weir in a stream where the flume is omitted. In such instances an apron, or a paved floor, should be provided to receive the falling water, otherwise the dam and weir would likely wash out.

Location of Weir.

A measuring weir should be placed on the farm lateral 50 feet or more below the head-gate which diverts the water from the canal. The head-gate should be set to let as much water flow over the weir as is desired and should then be locked.

How to Measure Water Over Weir.

After the weir has been set and a little time has been allowed for the water to reach its highest level, take any common rule or square graduated to inches and eights, and, holding it plumb, measure the depth of water from the nail in the top of the post or block, as the case may be. This measurement is never made on the weir-board, but always on the peg or block, set a considerable distance back from the weir board, as explained elsewhere.

Suppose the depth is found to be four and one-eighth inches, the observer should then follow down the first column in the table until 4⅛ inches is reached, then follow that line across the page to the column representing the length of the weir and read the discharge in cubic feet per second. If an 18 inch weir was used he would then follow down column one to 4⅛ inches and across the page to column headed 1½ foot weir and read the discharge 1.00 cubic foot per second.

If the irrigator wanted a full head of water with which to irrigate 10 acres, he should have about two second-feet with which the whole ten acres could be watered in about 20 hours. For such a quantity of water the crest of the weir should be two feet long and the depth over it about 5⅜ inches. On page two of the table, following down the column headed inches, to 5⅜, then to the right to the column showing the length of the weir crest to be 2 feet, the observer will find 2.03 second-feet for the discharge.

WORKING HEAD.

To get the most out of water and to apply it most economically, we should have as large a working head as one man can look after, say 1 to 2 "second-feet" or more, depending upon the ground, the skill of the irrigator, and the method of irrigation.

For South Idaho, Wayman recommends one to one and one-fourth second-feet. Walsh puts the top limit at 2 second-feet. Bliss says 2 second-feet for flooding and says irrigators must learn to use larger working heads under the rotation system and thus increase the efficiency of the water supply. Jessup says 1½ to 2 second-feet is the size of an average irrigation head in Colorado. Savage says it is a demonstrated and accepted fact that each irrigator should be given the largest head of water he can economically handle and retain it

on his land. Sanford says two second-feet is about the limit. He further says the delivery of water by rotation is the most practical and economical method, both from the view point of the canal operator and the water user.

If 4 acre-inches per acre be applied to average ground at each watering, it will wet the ground about 30 inches deep and put it in good growing condition. A working head of 2 second-feet would therefore irrigate 40 acres in about 80 hours, or 160 acres in approximately 13 1-3 days. If water, therefore, were distributed by rotation on a 7½ day interval, large farms would require more than one man to attend to the irrigating.

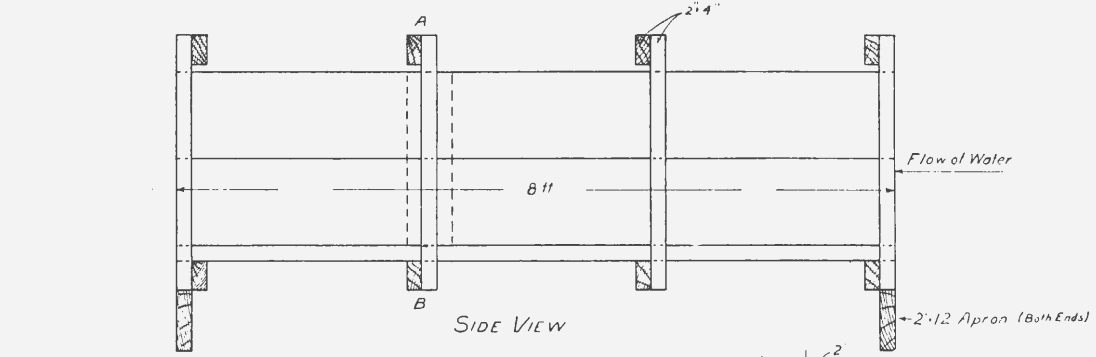
PROPORTIONED ACCORDING TO TIME.

The ordinary way of delivering a small stream of water continuously not only wastes the water, but squanders the time of the irrigator; while it over saturates the ground near the head ditches and leaves the crop to "burn" farthest away. With a large head or supply of water, all one man can conveniently distribute, the ground is quickly and evenly wet, and the farmer may then go about other duties, a very important one of which is the cultivation of the irrigated ground as soon as the surface is sufficiently dried.

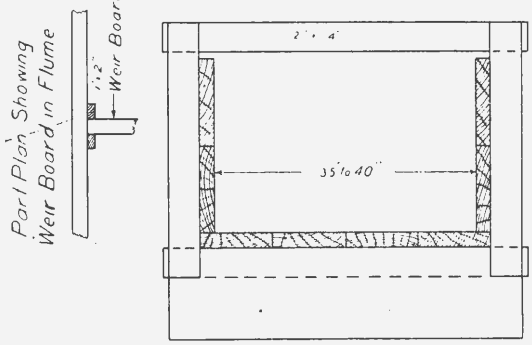
An arrangement between the farmers and the ditch companies providing for the distribution of water by rotation, so that each one would have a good working head when he wanted to irrigate, would be a great economy both to the farmers and to the ditch companies, and incidentally make the water now available go a good deal farther.

WEIR BOX Nº 1

To Measure from .25 to .50 Second Feet.

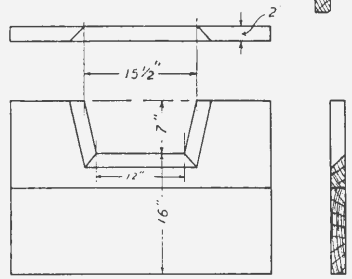


SIDE VIEW



END VIEW

Part Plan Showing Weir Board in Flume



WEIR BOARD at A–B

Scale 1 Ft.

6" 6"

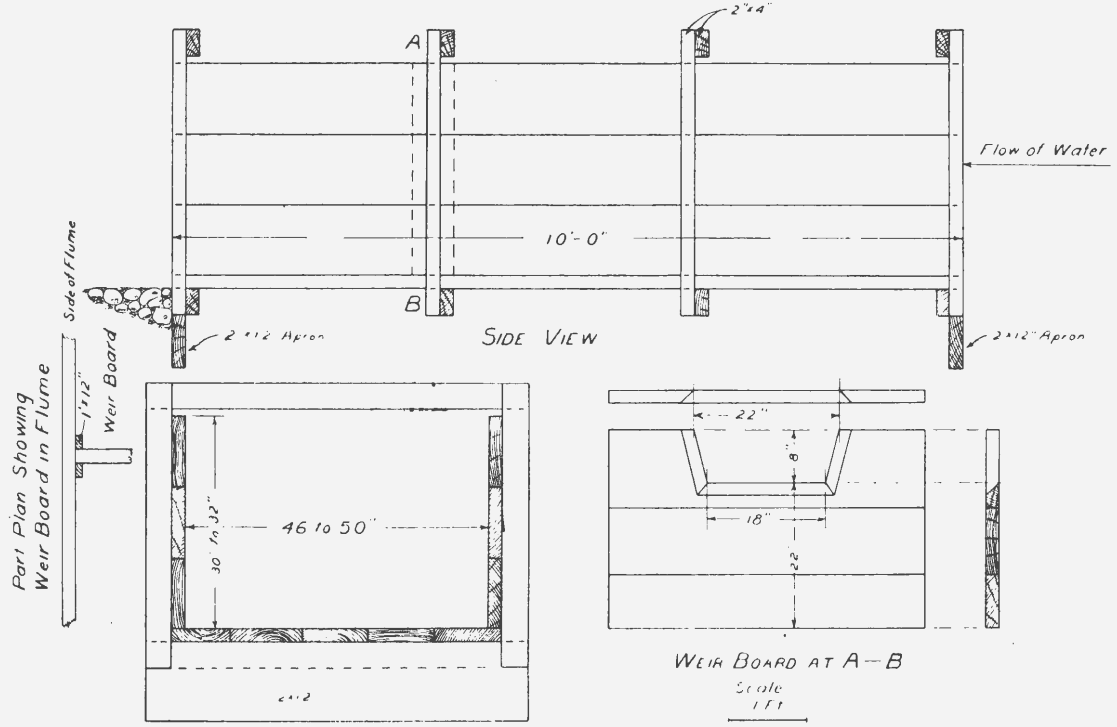
BILL OF MATERIAL FOR WEIR BOX NO. 1.

No. of Pieces	Actual Dimensions	B. M. Feet	Where Used	Remarks
	In. In. Ft. In.			
4	2 x 12 x 8	64	Lining, Sides	Lumber, Rough
3	2 x 12 x 8	48	Lining, Bottom	Lumber, Rough
1	2 x 10 x 8	13½	Lining, Bottom	Lumber, Rough
8	2 x 4 x 4 2	22 1-3	Sills and Ties	Lumber, Rough
8	2 x 4 x 2 10	15	Posts	Lumber, Rough
2	2 x 12 x 4 2	16 2-3	Aprons	Lumber, Rough
2	2 x 12 x 3 1½	12½	Weir Board	Clear Lumber Surface
4	1 x 2 x 2	1¼	Cleats, Sides	Clear Lumber Surface
2	1 x 2 x 3	1	Cleats, Bottom	Clear Lumber Surface

7 lbs. 20d. wire nails.
½ lb. 6d. wire nails.

WEIR BOX Nº 2

To Measure from .50 to 1.75 Second Feet



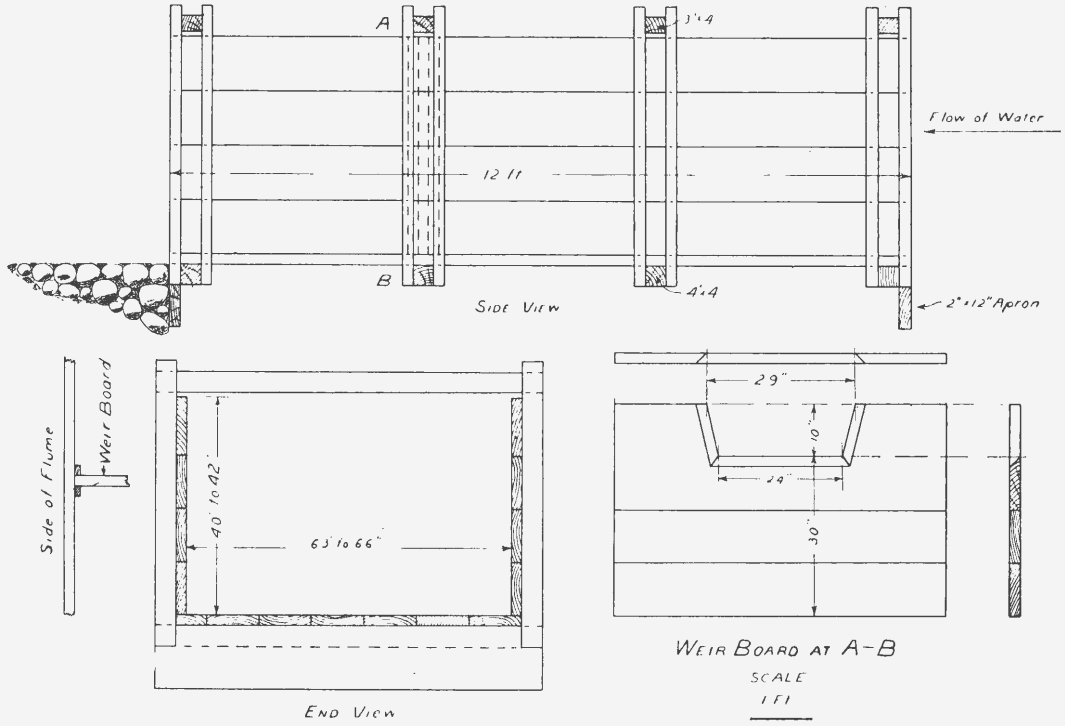
BILL OF MATERIAL FOR WEIR BOX NO. 2.

No. of Pieces	Actual Dimensions	B. M. Feet	Where Used	Remarks
	In. In. Ft. In.			
6	2 x 12 x 10	120	Lining, Sides	Lumber, Rough
4	2 x 12 x 10	80	Lining, Bottom	Lumber, Rough
1	2 x 6 x 10	10	Lining, Bottom	Lumber, Rough
8	2 x 4 x 5	26 2-3	Sills and Ties	Lumber, Rough
8	2 x 4 x 3 4	17¾	Posts	Lumber, Rough
2	2 x 12 x 5	20	Aprons	Lumber, Rough
2	2 x 12 x 4	16	Weir Board	Clear Lumber Surface
1	2 x 10 x 4	6 2-3	Weir Board	Clear Lumber Surface
4	1 x 2 x 2 6	1 2-3	Cleats, Sides	Clear Lumber Surface
2	1 x 2 x 4	1 1-3	Cleats, Bottom	Clear Lumber Surface

7½ lbs. 20d. wire nails.
½ lb. 6d. wire nails.

WEIR BOX Nº 3

To Measure from .75 to 3.5 Second Feet



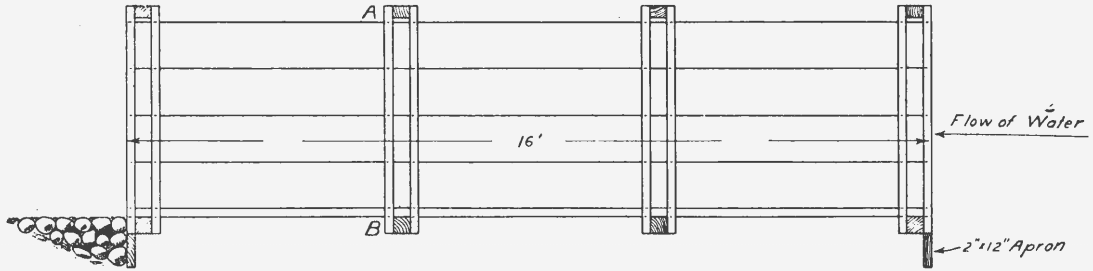
BILL OF MATERIAL FOR WEIR BOX NO. 3.

No. of Pieces	Actual Dimensions	B. M. Feet	Where Used	Remarks
	In. In. Ft. In.			
6	2 x 12 x 12	144	Lining, Sides	Lumber, Rough
2	2 x 10 x 12	40	Lining, Sides	Lumber, Rough
3	2 x 12 x 12	72	Lining, Bottom	Lumber, Rough
4	2 x 10 x 12	80	Lining, Bottom	Lumber, Rough
4	4 x 4 x 6 4	34	Sills	Lumber, Rough
4	3 x 4 x 6 4	24	Ties	Lumber, Rough
16	2 x 4 x 4 2	67	Posts	Lumber, Rough
2	2 x 12 x 6 4	25 1-3	Aprons	Lumber, Rough
1	2 x 18 x 5 4½	16	Weir Board	Clear Lumber Surface
2	2 x 12 x 5 4½	21½	Weir Board	Clear Lumber Surface
4	1 x 2 x 3 4	2¼	Cleats on Sides	Clear Lumber Surface
2	1 x 2 x 5 4½	1½	Cleats, Bottom	Clear Lumber Surface

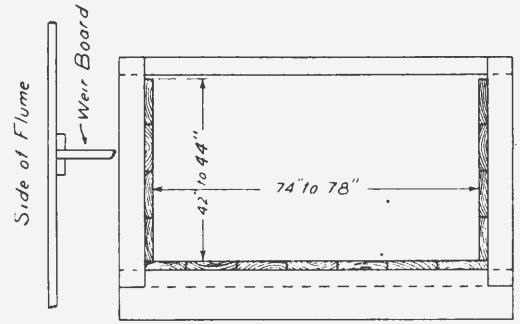
11 lbs. 20d. wire nails.
½ lb. 6d. wire nails.

WEIR BOX Nº 4

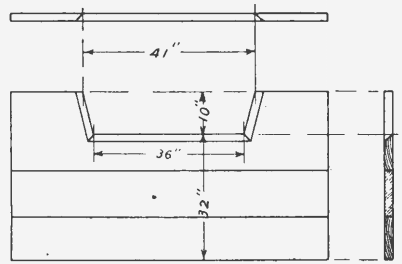
To Measure from 1. to 10 Second Feet



SIDE VIEW



END VIEW



WEIR BOARD AT A-B

Scale

BILL OF MATERIAL FOR WEIR BOX NO. 4.

No. of Pieces	Actual Dimensions	B. M. Feet	Where Used	Remarks
	In. In. Ft. In.			
6	2 x 12 x 16	190	Lining, Sides	Lumber, Rough
2	2 x 10 x 16	53 1-3	Lining, Sides	Lumber, Rough
4	2 x 12 x 16	128	Lining, Bottom	Lumber, Rough
4	2 x 10 x 16	106 2-3	Lining, Bottom	Lumber, Rough
4	4 x 4 x 7 8	40 8-9	Sills	Lumber, Rough
4	3 x 4 x 7 8	30 2-3	Ties	Lumber, Rough
16	2 x 6 x 4 4	69 1-3	Posts	Lumber, Rough
2	2 x 12 x 7 8	30 2-3	Aprons	Lumber, Rough
1	2 x 16 x 6 4	16 8-9	Weir Board	Clear Lumber surfaced
2	2 x 14 x 6 4	29 5-9	Weir Board	Clear Lumber surfaced
4	1 x 2 x 2 6	1 2-3	Cleats on Sides	Clear Lumber surfaced
2	1 x 2 x 6 4	2 1-9	Cleats, Bottom	Clear Lumber surfaced

12 lbs. 20d. wire nails.
1lb. 6d. wire nails.

DISCHARGE OVER CIPPOLETTI'S TRAPEZOIDAL WEIR.

For Various Lengths and Depths. Formula: $Q = 3.3\ 2\text{-}3\ LH^{\frac{3}{2}}$

Head "H" on Crest Measured to Still Water		Discharge in Cubic Feet per Second											
		Length of Weir Crest in Feet											
In ft.	In in.	1	1½	2	2½	3	3½	4	5	7½	10	12½	15
.01	⅛	.003	.01	.01	.01	.01	.01	.01	.02	.02	.03	.04	.05
.02	¼	.010	.01	.02	.02	.03	.03	.04	.05	.07	.10	.12	.14
.03	⅜	.018	.03	.04	.04	.05	.06	.07	.09	.13	.18	.22	.26
.04	½	.027	.04	.06	.07	.08	.09	.11	.13	.20	.27	.34	.40
.05	⅝	.038	.06	.08	.09	.11	.13	.15	.19	.28	.38	.47	.56
.06	¾	.050	.07	.10	.12	.15	.17	.20	.25	.37	.49	.62	.74
.07	⅞	.062	.09	.12	.16	.19	.22	.25	.31	.47	.62	.78	.94
.08	1	.076	.11	.15	.19	.23	.27	.30	.38	.57	.76	.95	1.14
.09	⅛	.091	.14	.18	.23	.27	.32	.36	.45	.68	.91	1.14	1.36
.10	¼	.107	.16	.21	.27	.32	.37	.43	.53	.80	1.06	1.33	1.60
.11	1⅜	.123	.18	.25	.31	.37	.43	.49	.61	.92	1.23	1.54	1.84
.12	½	.140	.21	.28	.35	.42	.49	.56	.70	1.05	1.40	1.75	2.10
.13	9/16	.158	.24	.32	.39	.47	.55	.63	.79	1.18	1.58	1.97	2.37
.14	⅝	.176	.26	.35	.44	.53	.62	.71	.88	1.32	1.76	2.20	2.65
.15	¾	.196	.29	.39	.49	.59	.68	.78	.98	1.47	1.96	2.44	2.93
.16	1⅞	.216	.32	.43	.54	.65	.75	.86	1.08	1.62	2.15	2.69	3.23
.17	2	.236	.35	.47	.59	.71	.83	.94	1.18	1.77	2.36	2.95	3.54
.18	⅛	.257	.39	.51	.64	.77	.90	1.03	1.29	1.93	2.57	3.21	3.86
.19	¼	.279	.42	.56	.70	.84	.98	1.12	1.39	2.09	2.79	3.49	4.18
.20	⅜	.301	.45	.60	.75	.90	1.05	1.20	1.51	2.26	3.01	3.76	4.52
.21	2½	.324	.49	.65	.81	.97	1.13	1.30	1.62	2.43	3.24	4.05	4.86
.22	⅝	.347	.52	.69	.87	1.04	1.22	1.39	1.74	2.61	3.47	4.34	5.21
.23	¾	.371	.56	.74	.93	1.11	1.30	1.49	1.86	2.79	3.71	4.64	5.57
.24	⅞	.396	.59	.79	.99	1.19	1.39	1.58	1.98	2.97	3.96	4.95	5.94
.25	3	.421	.63	.84	1.05	1.26	1.47	1.68	2.10	3.16	4.21	5.26	6.31
.26	3⅛	.446	.67	.89	1.12	1.34	1.56	1.79	2.23	3.35	4.46	5.58	6.70
.27	¼	.472	.71	.94	1.18	1.42	1.65	1.89	2.36	3.54	4.72	5.90	7.09
.28	⅜	.499	.75	1.00	1.25	1.50	1.75	2.00	2.49	3.74	4.99	6.24	7.48
.29	½	.526	.79	1.05	1.31	1.58	1.84	2.10	2.63	3.94	5.26	6.57	7.89
.30	⅝	.553	.83	1.11	1.38	1.66	1.94	2.21	2.77	4.15	5.53	6.92	8.30
.31	3¾	....	.87	1.16	1.45	1.74	2.03	2.32	2.91	4.36	5.81	7.26	8.72
.32	⅞	....	.91	1.22	1.52	1.83	2.13	2.44	3.05	4.57	6.09	7.62	9.14
.33	4	....	.96	1.28	1.60	1.91	2.23	2.55	3.19	4.79	6.38	7.98	9.57
.34	⅛	....	1.00	1.33	1.67	2.00	2.34	2.67	3.34	5.01	6.67	8.34	10.01
.35	¼	....	1.05	1.39	1.74	2.09	2.44	2.79	3.49	5.23	6.97	8.71	10.46
.36	4⅜	....	1.09	1.45	1.82	2.18	2.56	2.91	3.64	5.45	7.27	9.09	10.91
.37	½	....	1.14	1.52	1.89	2.27	2.65	3.03	3.79	5.68	7.58	9.47	11.37
.38	9/16	....	1.18	1.58	1.97	2.37	2.76	3.15	3.94	5.91	7.89	9.86	11.83
.39	⅝	....	1.23	1.64	2.05	2.46	2.87	3.28	4.10	6.15	8.20	10.25	12.30
.40	¾	....	1.28	1.70	2.13	2.56	2.98	3.41	4.26	6.39	8.52	10.65	12.78
.41	4⅞	....	1.33	1.77	2.21	2.65	3.09	3.54	4.42	6.63	8.84	11.05	13.26
.42	5	....	1.37	1.83	2.29	2.75	3.21	3.67	4.58	6.87	9.16	11.46	13.75
.43	⅛	....	1.42	1.90	2.37	2.85	3.32	3.80	4.75	7.12	9.49	11.87	14.24
.44	¼	....	1.47	1.97	2.46	2.95	3.44	3.93	4.91	7.37	9.83	12.28	14.74
.45	⅜	....	1.52	2.03	2.55	3.05	3.56	4.07	5.08	7.62	10.16	12.70	15.24
.46	5½	....	1.58	2.10	2.63	3.15	3.68	4.20	5.25	7.88	10.50	13.13	15.76
.47	⅝	....	1.63	2.17	2.71	3.25	3.80	4.34	5.42	8.14	10.85	13.56	16.27
.48	¾	....	1.68	2.24	2.80	3.36	3.92	4.48	5.60	8.40	11.20	14.00	16.79
.49	⅞	....	1.73	2.31	2.89	3.46	4.04	4.62	5.77	8.66	11.55	14.43	17.32
.50	6	....	1.79	2.38	2.98	3.57	4.17	4.76	5.95	8.93	11.90	14.88	17.85

DISCHARGE OVER CIPPOLETTI'S TRAPEZOIDAL WEIR—Continued.

For Various Lengths and Depths. Formula: $Q=3.3\ 2\text{-}3\ LH^{\frac{3}{2}}$

Head "H" on Crest Measured to Still Water		Discharge in Cubic Feet per Second											
		Length of Weir Crest in Feet											
In ft.	In in.	1½	2	2½	3	3½	4	5	7½	10	12½	15	18
.51	6⅛	1.84	2.45	3.07	3.68	4.29	4.90	6.13	9.20	12.26	15.33	18.39	22.07
.52	¼	1.89	2.52	3.16	3.79	4.42	5.05	6.31	9.47	12.62	15.78	18.94	22.72
.53	⅜	1.95	2.60	3.25	3.90	4.55	5.20	6.50	9.74	12.99	16.24	19.49	23.38
.54	½	2.00	2.67	3.34	4.01	4.68	5.34	6.68	10.02	13.36	16.70	20.04	24.05
.55	⅝	2.06	2.75	3.43	4.12	4.81	5.49	6.87	10.30	13.73	17.17	20.60	24.72
.56	6¾	2.12	2.82	3.53	4.23	4.94	5.64	7.05	10.58	14.11	17.64	21.16	25.40
.57	⅞	2.17	2.90	3.62	4.35	5.07	5.80	7.24	10.87	14.49	18.11	21.73	26.08
.58	7	2.23	2.97	3.72	4.46	5.20	5.95	7.44	11.15	14.87	18.59	22.31	26.77
.59	⅛	2.29	3.05	3.81	4.58	5.34	6.10	7.63	11.44	15.26	19.07	22.89	27.46
.60	¼	2.35	3.13	3.91	4.69	5.48	6.26	7.82	11.74	15.65	19.56	23.47	28.16
.61	7⅜	....	3.21	4.01	4.81	5.61	6.42	8.02	12.03	16.04	20.05	24.06	28.87
.62	½	....	3.29	4.11	4.93	5.75	6.57	8.22	12.33	16.44	20.54	24.65	29.58
.63	9/16	....	3.37	4.21	5.05	5.89	6.73	8.42	12.63	16.83	21.04	25.25	30.30
.64	⅝	....	3.45	4.31	5.17	6.03	6.89	8.62	12.93	17.24	21.55	25.86	31.03
.65	¾	....	3.53	4.41	5.29	6.18	7.06	8.82	13.23	17.64	22.05	26.46	31.76
.66	7⅞	....	3.61	4.51	5.42	6.32	7.22	9.03	13.54	18.05	22.56	27.08	32.49
.67	8	....	3.69	4.62	5.54	6.46	7.39	9.23	13.85	18.46	23.08	27.70	33.23
.68	⅛	....	3.78	4.72	5.66	6.61	7.55	9.44	14.16	18.88	23.60	28.32	33.98
.69	¼	....	3.86	4.82	5.79	6.75	7.72	9.65	14.47	19.30	24.12	28.94	34.73
.70	⅜	....	3.94	4.93	5.92	6.90	7.89	9.86	14.79	19.72	24.65	29.58	35.49
.71	8½	....	4.03	5.04	6.04	7.05	8.06	10.07	15.11	20.14	25.18	30.21	36.25
.72	⅝	....	4.11	5.14	6.17	7.20	8.23	10.28	15.43	20.57	25.71	30.85	37.03
.73	¾	....	4.20	5.25	6.30	7.35	8.40	10.50	15.75	21.00	26.25	31.50	37.80
.74	⅞	....	4.29	5.36	6.43	7.50	8.57	10.72	16.07	21.43	26.79	32.15	38.58
.75	9	....	4.37	5.47	6.56	7.65	8.75	10.93	16.40	21.87	27.33	32.80	39.36
.76	9⅛	....	4.46	5.58	6.69	7.81	8.92	11.15	16.73	22.31	27.88	33.46	40.15
.77	¼	....	4.55	5.69	6.82	7.96	9.10	11.37	17.06	22.75	28.43	34.12	40.95
.78	⅜	....	4.64	5.80	6.96	8.12	9.28	11.60	17.39	23.19	28.99	34.79	41.75
.79	½	....	4.73	5.91	7.09	8.27	9.46	11.82	17.73	23.64	29.55	35.46	42.55
.80	⅝	....	4.82	6.02	7.23	8.43	9.64	12.05	18.07	24.09	30.11	36.13	43.36
.81	9¾	....	4.91	6.14	7.36	8.59	9.82	12.27	18.41	24.54	30.68	36.81	44.18
.82	⅞	....	5.00	6.25	7.50	8.75	10.00	12.50	18.75	25.00	31.25	37.50	45.00
.83	10	....	5.09	6.36	7.64	8.91	10.18	12.73	19.09	25.46	31.82	38.19	45.82
.84	⅛	....	5.18	6.48	7.78	9.07	10.37	12.96	19.44	25.92	32.40	38.88	46.65
.85	¼	....	5.28	6.60	7.92	9.23	10.55	13.19	19.79	26.38	32.98	39.57	47.49
.86	10⅜	....	5.37	6.71	8.06	9.40	10.74	13.43	20.14	26.85	33.56	40.28	48.33
.87	½	....	5.46	6.83	8.20	9.56	10.93	13.66	20.49	27.32	34.15	40.97	49.18
.88	9/16	....	5.56	6.95	8.34	9.73	11.12	13.90	20.84	27.79	34.74	41.69	50.03
.89	⅝	....	5.65	7.07	8.48	9.89	11.31	14.13	21.20	28.27	35.33	42.40	50.88
.90	¾	....	5.75	7.19	8.62	10.06	11.50	14.37	21.56	28.75	35.93	43.12	51.74
.91	10⅞	....	....	7.31	8.77	10.23	11.69	14.61	21.92	29.23	36.53	43.84	52.61
.92	11	....	....	7.43	8.91	10.40	11.88	14.85	22.28	29.71	37.14	44.56	53.48
.93	⅛	....	....	7.55	9.06	10.57	12.08	15.10	22.65	30.19	37.74	45.29	54.35
.94	¼	....	....	7.67	9.20	10.74	12.27	15.34	23.01	30.68	38.35	46.02	55.23
.95	⅜	....	....	7.79	9.35	10.91	12.47	15.59	23.38	31.17	38.97	46.76	56.11
.96	11½	....	....	7.92	9.50	11.08	12.67	15.83	23.75	31.67	39.58	47.50	57.00
.97	⅝	....	....	8.04	9.65	11.26	12.87	16.08	24.12	32.16	40.20	48.24	57.89
.98	¾	....	....	8.17	9.80	11.43	13.06	16.33	24.49	32.66	40.83	48.99	58.79
.99	⅞	....	....	8.29	9.95	11.61	13.27	16.58	24.87	33.16	41.45	49.74	59.69
1.00	12	....	....	8.42	10.10	11.78	13.47	16.83	25.25	33.67	42.08	50.50	60.60

DISCHARGE OVER CIPPOLETTI'S TRAPEZOIDAL WEIR—Continued.

For Various Lengths and Depths. Formula: $Q = 3.3\ 2\text{-}3\ LH^{\frac{3}{2}}$

Head "H" on Crest Measured to Still Water		Discharge in Cubic Feet per Second										
		Length of Weir Crest in Feet										
In feet	In in.	2½	3	3½	4	5	7½	10	12½	15	18	20
1.01	12⅛	8.54	10.25	11.96	13.67	17.09	25.63	34.17	42.72	51.26	61.51	68.35
1.02	¼	8.67	10.40	12.14	13.87	17.34	26.01	34.68	43.35	52.02	62.43	69.36
1.03	⅜	8.80	10.56	12.32	14.08	17.60	26.39	35.19	43.99	52.79	63.35	70.39
1.04	½	8.93	10.71	12.50	14.28	17.85	26.78	35.71	44.63	53.56	64.27	71.41
1.05	⅝	9.06	10.87	12.68	14.49	18.11	27.17	36.22	45.28	54.33	65.20	72.45
1.06	12¾	9.19	11.02	12.86	14.70	18.37	27.56	36.74	45.93	55.11	66.14	73.48
1.07	⅞	9.32	11.18	13.04	14.91	18.63	27.95	37.26	46.58	55.89	67.07	74.53
1.08	13	9.45	11.34	13.23	15.11	18.89	28.34	37.79	47.23	56.68	68.02	75.57
1.09	⅛	9.58	11.49	13.41	15.33	19.16	28.73	38.31	47.89	57.47	68.96	76.62
1.10	¼	9.71	11.65	13.59	15.54	19.42	29.13	38.84	48.55	58.26	69.91	77.68
1.11	13⅜	9.84	11.81	13.78	15.75	19.69	29.53	39.37	49.21	59.06	70.87	78.74
1.12	½	9.98	11.97	13.97	15.96	19.95	29.93	39.90	49.88	59.86	71.83	79.81
1.13	9/16	10.11	12.13	14.15	16.18	20.22	30.33	40.44	50.55	60.66	72.79	80.88
1.14	⅝	10.24	12.29	14.34	16.39	20.49	30.73	40.98	51.22	61.47	73.76	81.96
1.15	¾	10.38	12.46	14.53	16.61	20.76	31.14	41.52	51.90	62.28	74.73	83.04
1.16	13⅞	10.52	12.62	14.72	16.82	21.03	31.55	42.06	52.58	63.09	75.71	84.12
1.17	14	10.65	12.78	14.91	17.04	21.30	31.96	42.61	53.26	63.91	76.69	85.21
1.18	⅛	10.79	12.95	15.10	17.26	21.58	32.37	43.15	53.94	64.73	77.68	86.31
1.19	¼	10.93	13.11	15.30	17.48	21.85	32.78	43.70	54.63	65.56	78.67	87.41
1.20	⅜	11.06	13.28	15.49	17.70	22.13	33.19	44.26	55.32	66.38	79.66	88.51
1.21	14½	.....	13.44	15.68	17.92	22.41	33.61	44.81	56.01	67.22	80.66	89.62
1.22	⅝	.....	13.61	15.88	18.15	22.68	34.03	45.37	56.71	68.05	81.66	90.73
1.23	¾	.....	13.78	16.07	18.37	22.96	34.44	45.93	57.41	68.89	82.67	91.85
1.24	⅞	.....	13.95	16.27	18.59	23.24	34.87	46.49	58.11	69.73	83.68	92.97
1.25	15	.....	14.12	16.47	18.82	23.53	35.29	47.05	58.81	70.58	84.69	94.10
1.26	15⅛	.....	14.28	16.67	19.05	23.81	35.71	47.62	59.52	71.42	85.71	95.23
1.27	¼	.....	14.46	16.86	19.27	24.09	36.14	48.18	60.23	72.28	86.74	96.37
1.28	⅜	.....	14.63	17.06	19.50	24.38	36.57	48.75	60.94	73.13	87.76	97.51
1.29	½	.....	14.80	17.26	19.73	24.66	37.00	49.33	61.66	73.99	88.79	98.65
1.30	⅝	.....	14.97	17.47	19.96	24.95	37.43	49.90	62.38	74.85	89.82	99.80
1.31	15¾	.....	15.14	17.67	20.19	25.24	37.86	50.48	63.10	75.72	90.86	100.96
1.32	⅞	.....	15.32	17.87	20.42	25.53	38.29	51.06	63.82	76.59	91.90	102.12
1.33	16	.....	15.49	18.07	20.66	25.82	38.73	51.64	64.55	77.46	92.95	103.28
1.34	⅛	.....	15.67	18.28	20.89	26.11	39.17	52.22	65.28	78.33	94.00	104.45
1.35	¼	.....	15.84	18.48	21.12	26.40	39.61	52.81	66.01	79.21	95.05	105.62
1.36	16⅜	.....	16.02	18.69	21.36	26.70	40.05	53.40	66.74	80.09	96.11	106.79
1.37	½	.....	16.20	18.90	21.59	26.99	40.49	53.99	67.48	80.98	97.18	107.97
1.38	9/16	.....	16.37	19.10	21.83	27.29	40.93	54.58	68.22	81.87	98.25	109.16
1.39	⅝	.....	16.55	19.31	22.07	27.59	41.38	55.17	68.97	82.76	99.31	110.35
1.40	¾	.....	16.73	19.52	22.31	27.88	41.83	55.77	69.71	83.65	100.38	111.54
1.41	16⅞	.....	16.91	19.73	22.55	28.18	42.28	56.37	70.46	84.55	101.46	112.74
1.42	17	.....	17.09	19.94	22.79	28.48	42.73	56.97	71.21	85.45	102.54	113.94
1.43	⅛	.....	17.27	20.15	23.03	28.79	43.18	57.57	71.96	86.36	103.63	115.14
1.44	¼	.....	17.45	20.36	23.27	29.09	43.63	58.18	72.72	87.26	104.72	116.35
1.45	⅜	.....	17.63	20.57	23.51	29.39	44.09	58.78	73.48	88.17	105.81	117.57
1.46	17½	.....	17.82	20.79	23.76	29.70	44.54	59.39	74.24	89.09	106.91	118.78
1.47	⅝	.....	18.00	21.00	24.00	30.00	45.00	60.00	75.00	90.01	108.01	120.01
1.48	¾	.....	18.19	21.22	24.25	30.31	45.46	60.62	75.77	90.93	109.11	121.23
1.49	⅞	.....	18.37	21.43	24.49	30.62	45.92	61.23	76.54	91.85	110.22	122.46
1.50	18	.....	18.55	21.65	24.74	30.92	46.39	61.85	77.31	92.77	111.33	123.70

DISCHARGE OVER CIPPOLETTI'S TRAPEZOIDAL WEIR—Continued.

For Various Lengths and Depths. Formula: $Q = 3.3\ 2\text{-}3\ LH^{\frac{3}{2}}$

Head "H" on Crest Measured to Still Water		Discharge in Cubic Feet per Second								
		Length of Weir Crest in Feet								
In feet	In in.	3½	4	5	7½	10	12½	15	18	20
1.51	18⅛	21.86	24.99	31.23	46.85	62.47	78.09	93.70	112.44	124.94
1.52	¼	22.08	25.24	31.55	47.32	63.09	78.86	94.64	113.56	126.18
1.53	⅜	22.30	25.49	31.86	47.79	63.71	79.64	95.57	114.69	127.43
1.54	½	22.52	25.74	32.17	48.26	64.34	80.43	96.51	115.81	128.68
1.55	⅝	22.74	25.99	32.48	48.73	64.97	81.21	97.45	116.94	129.94
1.56	18¾	22.96	26.24	32.80	49.20	65.60	82.00	98.40	118.08	131.19
1.57	⅞	23.18	26.49	33.11	49.67	66.23	82.79	99.34	119.21	132.46
1.58	19	23.40	26.75	33.43	50.15	66.86	83.58	100.29	120.35	133.73
1.59	⅛	23.62	27.00	33.75	50.62	67.50	84.37	101.25	121.50	135.00
1.60	¼	23.85	27.25	34.07	51.10	68.14	85.17	102.20	122.65	136.27
1.61	19⅜	24.07	27.51	34.39	51.58	68.78	85.97	103.16	123.80	137.55
1.62	½	24.30	27.77	34.71	52.06	69.42	86.77	104.13	124.95	138.84
1.63	9/16	24.52	28.02	35.03	52.55	70.06	87.58	105.09	126.11	140.12
1.64	⅝	24.75	28.28	35.35	53.03	70.71	88.38	106.06	127.27	141.42
1.65	¾	24.97	28.54	35.68	53.52	71.36	89.19	107.03	128.44	142.71
1.66	19⅞	25.20	28.80	36.00	54.00	72.00	90.01	108.01	129.61	144.01
1.67	20	25.43	29.06	36.33	54.49	72.66	90.82	108.98	130.78	145.31
1.68	⅛	25.66	29.32	36.66	54.98	73.31	91.64	109.97	131.96	146.62
1.69	¼	25.89	29.59	36.98	55.47	73.97	92.46	110.95	133.14	147.93
1.70	¾	26.12	29.85	37.31	55.97	74.62	93.28	111.93	134.32	149.25
1.71	20½	26.35	30.11	37.64	56.46	75.28	94.10	112.92	135.51	150.57
1.72	⅝	26.58	30.38	37.97	56.96	75.94	94.93	113.92	136.70	151.89
1.73	¾	26.81	30.64	38.30	57.46	76.61	95.76	114.91	137.89	153.21
1.74	⅞	27.05	30.91	38.64	57.95	77.27	96.59	115.91	139.09	154.54
1.75	21	27.28	31.18	38.97	58.45	77.94	97.42	116.91	140.29	155.88
1.76	21⅛	27.51	31.44	39.30	58.96	78.61	98.26	117.91	141.50	157.22
1.77	¼	27.75	31.71	39.64	59.46	79.28	99.10	118.92	142.70	158.56
1.78	⅜	27.98	31.98	39.98	59.96	79.95	99.94	119.93	143.91	159.90
1.79	½	28.22	32.25	40.31	60.47	80.63	100.78	120.94	145.13	161.25
1.80	⅝	28.46	32.52	40.65	60.98	81.30	101.63	121.96	146.35	162.61
1.81	21¾	.....	32.79	40.99	61.49	81.98	102.48	122.97	147.57	163.96
1.82	⅞	.....	33.06	41.33	62.00	82.66	103.33	123.99	148.79	165.32
1.83	22	.....	33.34	41.67	62.51	83.34	104.18	125.02	150.02	166.69
1.84	⅛	.....	33.61	42.01	63.02	84.03	105.04	126.04	151.25	168.06
1.85	¼	.....	33.89	42.36	63.54	84.71	105.89	127.07	152.49	169.43
1.86	22⅜	.....	34.16	42.70	64.05	85.40	106.75	128.10	153.72	170.80
1.87	½	.....	34.44	43.05	64.57	86.09	107.61	129.14	154.97	172.18
1.88	9/16	.....	34.71	43.39	65.09	86.78	108.48	130.18	156.21	173.57
1.89	⅝	.....	34.99	43.74	65.61	87.48	109.35	131.22	157.46	174.95
1.90	¾	.....	35.27	44.09	66.13	88.17	110.22	132.26	158.71	176.34
1.91	22⅞	.....	35.55	44.43	66.65	88.87	111.09	133.30	159.96	177.74
1.92	23	.....	35.83	44.78	67.18	89.57	111.96	134.35	161.22	179.14
1.93	⅛	.....	36.11	45.13	67.70	90.27	112.84	135.40	162.48	180.54
1.94	¼	.....	36.39	45.49	68.23	90.97	113.71	136.46	163.75	181.94
1.95	⅜	.....	36.67	45.84	68.76	91.68	114.59	137.51	165.02	183.35
1.96	23½	.....	36.95	46.19	69.29	92.38	115.48	138.57	166.29	184.76
1.97	⅝	.....	37.24	46.54	69.82	93.09	116.36	139.63	167.56	186.18
1.98	¾	.....	37.52	46.90	70.35	93.80	117.25	140.70	168.84	187.60
1.99	⅞	.....	37.80	47.26	70.88	94.51	118.14	141.77	170.12	189.02
2.00	24	.....	38.09	47.61	71.42	95.22	119.03	142.84	171.40	190.45

DISCHARGE OVER CIPPOLETTI'S TRAPEZOIDAL WEIR—Continued.

For Various Lengths and Depths. Formula: $Q = 3.3\ 2\text{-}3\ LH^{\frac{3}{2}}$

Head "H" on Crest Measured to Still Water		Discharge in Cubic Feet per Second							
		Length of Weir Crest in Feet							
In feet	In inches	4	5	7½	10	12½	15	18	20
2.01	24 1/8	38.38	47.97	71.95	95.94	119.92	143.91	172.69	191.88
2.02	1/4	38.66	48.33	72.49	96.66	120.82	144.98	173.98	193.31
2.03	3/8	38.95	48.69	73.03	97.37	121.72	146.06	175.27	195.75
2.04	1/2	39.24	49.05	73.57	98.09	122.62	147.14	176.57	196.19
2.05	5/8	39.53	49.41	74.11	98.82	123.52	148.23	177.87	197.63
2.06	24 3/4	39.82	49.77	74.66	99.54	124.43	149.31	179.17	199.08
2.07	7/8	40.11	50.13	75.20	100.27	125.33	150.40	180.48	200.53
2.08	25	40.40	50.50	75.75	100.99	126.24	151.49	181.79	201.99
2.09	1/8	40.69	50.86	76.29	101.72	127.15	152.58	183.10	203.45
2.10	1/4	40.98	51.23	76.84	102.45	128.07	153.68	184.42	204.91
2.11	25 3/8	.....	51.59	77.39	103.19	128.98	154.78	185.74	206.37
2.12	1/2	.....	51.96	77.94	103.92	129.90	155.88	187.06	207.84
2.13	9/16	.....	52.33	78.49	104.66	130.82	156.99	188.38	209.31
2.14	5/8	.....	52.70	79.05	105.40	131.74	158.09	189.71	210.79
2.15	3/4	.....	53.07	79.60	106.13	132.67	159.20	191.04	212.27
2.16	25 7/8	.....	53.44	80.16	106.88	133.60	160.31	192.38	213.75
2.17	26	.....	53.81	80.71	107.62	134.52	161.43	193.71	215.24
2.18	1/8	.....	54.18	81.27	108.36	135.45	162.55	195.06	216.73
2.19	1/4	.....	54.56	81.83	109.11	136.39	163.67	196.40	218.22
2.20	3/8	.....	54.93	82.39	109.86	137.32	164.79	197.75	219.72
2.21	26 1/2	.....	55.30	82.96	110.61	138.26	165.91	199.10	221.22
2.22	5/8	.....	55.68	83.52	111.36	139.20	167.04	200.45	222.72
2.23	3/4	.....	56.06	84.09	112.11	140.14	168.17	201.80	224.23
2.24	7/8	.....	56.43	84.65	112.87	141.09	169.30	203.16	225.74
2.25	27	.....	56.81	85.22	113.63	142.03	170.44	204.53	227.25
2.26	27 1/8	.....	57.19	85.79	114.38	142.98	171.58	205.89	228.77
2.27	1/4	.....	57.57	86.36	115.14	143.93	172.72	207.26	230.29
2.28	3/8	.....	57.96	86.93	115.91	144.88	173.86	208.63	231.81
2.29	1/2	.....	58.33	87.50	116.67	145.84	175.00	210.00	233.34
2.30	5/8	.....	58.72	88.08	117.43	146.79	176.15	211.38	234.87
2.31	27 3/4	.....	59.10	88.65	118.20	147.75	177.30	212.76	236.40
2.32	7/8	.....	59.48	89.23	118.97	148.71	178.45	214.14	237.94
2.33	28	.....	59.87	89.80	119.74	149.67	179.61	215.53	239.48
2.34	1/8	.....	60.26	90.38	120.51	150.64	180.77	216.92	241.02
2.35	1/4	.....	60.64	90.96	121.28	151.60	181.93	218.31	242.57
2.36	28 3/8	.....	61.03	91.54	122.06	152.57	183.09	219.71	244.12
2.37	1/2	.....	61.42	92.13	122.84	153.54	184.25	221.10	245.67
2.38	9/16	.....	61.81	92.71	123.61	154.52	185.42	222.50	247.23
2.39	5/8	.....	62.20	93.30	124.39	155.49	186.59	223.91	248.79
2.40	3/4	.....	62.59	93.88	125.17	156.47	187.76	225.31	250.35
2.41	28 7/8	.....	.....	94.47	125.96	157.45	188.94	226.72	251.92
2.42	29	.....	.....	95.06	126.74	158.43	190.11	228.14	253.49
2.43	1/8	.....	.....	95.65	127.53	159.41	191.29	229.55	255.06
2.44	1/4	.....	.....	96.24	128.32	160.40	192.48	230.97	256.63
2.45	3/8	.....	.....	96.83	129.11	161.38	193.66	232.39	258.21
2.46	29 1/2	.....	.....	97.42	129.90	162.37	194.85	233.82	259.80
2.47	5/8	.....	.....	98.02	130.69	163.36	196.04	235.24	261.38
2.48	3/4	.....	.....	98.61	131.49	164.36	197.23	236.67	262.97
2.49	7/8	.....	.....	99.21	132.28	165.35	198.42	238.11	264.56
2.50	30	.....	.....	99.81	133.08	166.35	199.62	239.54	266.16

DISCHARGE OVER CIPPOLETTI'S TRAPEZOIDAL WEIR—Continued.

For Various Lengths and Depths. Formula: $Q=3.3\ 2\text{-}3\ LH^{\frac{3}{2}}$

Head "H" on Crest Measured to Still Water		Discharge in Cubic Feet per Second					
		Length of Weir Crest in Feet					
In feet	In inches	7½	10	12½	15	18	20
2.51	30⅛	100.41	133.88	167.35	200.82	240.98	267.76
2.52	¼	101.01	134.68	168.35	202.02	242.42	269.36
2.53	⅜	101.61	135.48	169.35	203.22	243.87	270.96
2.54	½	102.21	136.29	170.36	204.43	245.31	272.57
2.55	⅝	102.82	137.09	171.36	205.64	246.76	274.18
2.56	30¾	103.42	137.90	172.37	206.85	248.22	275.80
2.57	⅞	104.03	138.71	173.38	208.06	249.67	277.41
2.58	31	104.64	139.52	174.40	209.28	251.13	279.04
2.59	⅛	105.25	140.33	175.41	210.49	252.59	280.66
2.60	¼	105.86	141.14	176.43	211.71	254.06	282.29
2.61	31⅜	106.47	141.96	177.45	212.94	255.53	283.92
2.62	½	107.08	142.77	178.47	214.16	256.99	285.55
2.63	9/16	107.69	143.59	179.49	215.39	258.47	287.19
2.64	⅝	108.31	144.41	180.52	216.62	259.94	288.83
2.65	¾	108.93	145.23	181.54	217.85	261.42	290.47
2.66	31⅞	109.54	146.06	182.57	219.09	262.90	292.11
2.67	32	110.16	146.88	183.60	220.32	264.39	293.76
2.68	⅛	110.78	147.71	184.63	221.56	265.97	295.41
2.69	¼	111.40	148.53	185.67	222.80	267.36	297.07
2.70	⅜	112.02	149.36	186.70	224.05	268.86	298.73
2.71	32½	112.65	150.19	187.74	225.29	270.35	300.39
2.72	⅝	113.27	151.03	188.78	226.54	271.85	302.05
2.73	¾	113.90	151.86	189.83	227.79	273.35	303.72
2.74	⅞	114.52	152.70	190.87	229.04	274.85	305.39
2.75	33	115.15	153.53	191.92	230.30	276.36	307.06
2.76	33⅛	115.78	154.37	192.96	231.56	277.87	308.74
2.77	¼	116.41	155.21	194.01	232.82	279.38	310.42
2.78	⅜	117.04	156.05	195.06	234.08	280.89	312.10
2.79	½	117.67	156.89	196.12	235.34	282.41	313.79
2.80	⅝	118.30	157.74	197.17	236.61	283.93	315.48
2.81	33¾	118.94	158.58	198.23	237.88	285.45	317.17
2.82	⅞	119.57	159.43	199.29	239.15	286.98	318.86
2.83	34	120.21	160.28	200.35	240.42	288.50	320.56
2.84	⅛	120.85	161.13	201.41	241.70	290.03	322.26
2.85	¼	121.49	161.98	202.48	242.97	291.57	323.96
2.86	34⅜	122.13	162.84	203.54	244.25	293.10	325.67
2.87	½	122.77	163.69	204.61	245.54	294.64	327.38
2.88	9/16	123.41	164.55	205.68	246.82	296.18	329.09
2.89	⅝	124.05	165.40	206.76	248.11	297.73	330.81
2.90	¾	124.70	166.26	207.83	249.40	299.27	332.53
2.91	34⅞	125.34	167.12	208.91	250.69	300.82	334.25
2.92	35	125.99	167.99	209.98	251.98	302.38	335.97
2.93	⅛	126.64	168.85	211.06	253.28	303.93	337.70
2.94	¼	127.29	169.72	212.14	254.57	305.49	339.43
2.95	⅜	127.94	170.58	213.23	255.87	307.05	341.16
2.96	35½	128.59	171.45	214.31	257.18	308.61	342.90
2.97	⅝	129.24	172.32	215.40	258.48	310.18	344.64
2.98	¾	129.89	173.19	216.49	259.79	311.74	346.38
2.99	⅞	130.55	174.06	217.58	261.09	313.31	348.13
3.00	36	131.20	174.94	218.67	262.41	314.89	349.87