COOPERATIVE EXTENSION SERVICE WEST VIRGINIA UNIVERSITY

Agricultural Engineering

SW - 5
A. W. Selders

MEASURING SURFACE-WATER FLOW USING WEIRS

Surface waters can be used for irrigation and frost control in certain areas of West Virginia. When contemplating the use of this source the quantity of water available must be determined before a system is designed. Flow measurements should be taken at low flow periods because irrigation requirements will usually be highest when stream flow is the lowest.

Methods commonly used for measuring surface-water flow can be grouped into three categories: (1) methods using a formed constriction in the cross section of the stream or ditch; (2) velocity-area methods; (3) direct methods. Three types of formed constrictions, called weirs, will be described here: (1) V-notch or triangular; (2) rectangular contracted; (3) Cipolletti.

A weir is a notch of regular form through which water may flow. Weirs can be made with plywood or with l-inch boards and 2 x 4's. The reliability of weir measurements is affected by construction and installation, but when properly constructed and installed, weirs are one of the simplest and most accurate methods of measuring water flow.

Installing a Weir

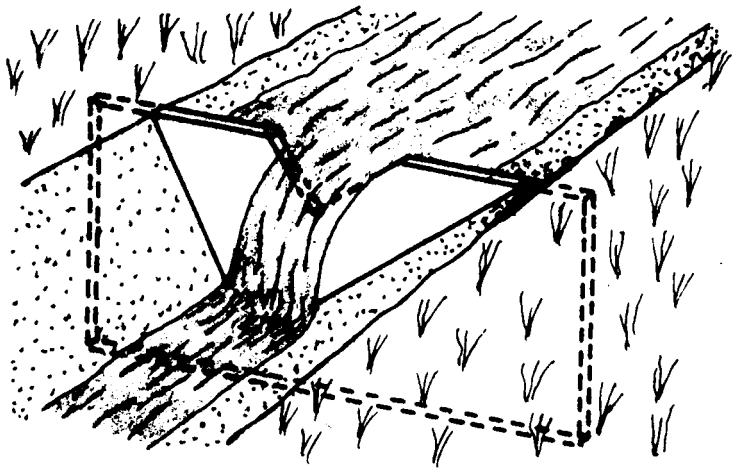
1. The weir structure should be set in a channel that is straight for a distance upstream from the weir equal to at least 10 times the length of the weir crest.
2. The weir should be placed at right angles to the direction of water flow.
3. The face of the weir should be perpendicular; the weir crest straight and level.
4. Obstructions on the upstream side of the weir should be avoided.
5. The crest and sides of the weir notch should not be more than 1/8 inch thick.
6. If possible, the weir structure should be set at the downstream end of a long pool sufficiently wide and deep so that the water will approach the weir free from eddies, at a velocity not exceeding 0.5 foot per second.
7. The height of the crest of the weir above the channel bottom, upstream from the weir, should be at least twice, preferably three times the depth (or head) of the water flowing over the crest.
8. The distance from the side of the weir notch to the sides of the channel should be at least twice the depth (or head) of water passing over the crest.
9. Length of the weir crest should be such that the head to be measured exceeds 2 inches with the maximum head no greater than 1/3 the length of the weir crest.

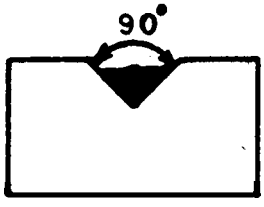
Measuring the Head on a Weir

Measure the depth of water (head) passing over the weir crest at a point upstream from the crest where the surface drawdown curve does not affect the measurement. This can be done by driving a stake in the pool at a distance upstream at least 5 or 6 times the depth of flow over the weir notch. The top of the stake should be level with the weir crest. The distance from the top of the weir to the water surface is the head and can be measured with a scale. A staff gage placed at the proper place in the pool with the zero on the gage level with the weir crest or a hook gage and stilling well may also be used for measuring the head.

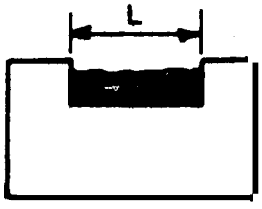
TABLE 1 APPROXIMATE FLOW OVER A 90° TRIANGULAR WEIR

Head in inches H	Gallons per minute GPM	Acre - inches per hour Ac-in/hr
	36	0.08
3	74	0.16
5	126	0.28
6	200	0.44
7	294	0.65
8	405	0.89
9	548	1.21
10	714	1.58
11	895	1.98
12	1118	2.48

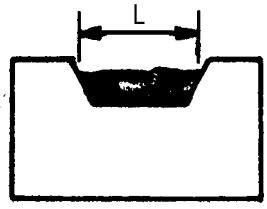




V-NOTCH OR TRIANGULAR



RECTANGULAR CONTRACTED



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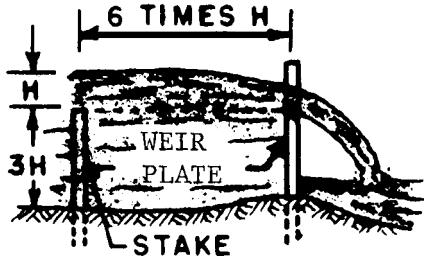

MEASURING HEAD ON A WEIR

TABLE 2 APPROXIMATE FLOW OVER RECTANGULAR CONTRACTED WEIRS

Head in inches	Crest Length (L) 1 foot		2 feet		3 feet		4 feet	
H	GPM	Ac-in/hr	GPM	Ac-in/hr	GPM	Ac-in/hr	GPM	Ac-in/hr
2	98	0.22	198	0.44	298	0.66	398	0.88
3	181	0.40	366	0.81	552	1.22	738	1.63
4	278	0.62	560	1.24	852	1.88	1140	2.52
5	-	-	772	1.70	1164	2.58	1560	3.45
6	-	-	1010	2.22	1535	3.40	2055	4.54
7	-	-	1270	2.80	1930	4.27	2590	5.75
8	-	-	1540	3.40	2330	5.18	3120	6.90

TABLE 3 APPROXIMATE FLOW OVER CIPOLLETTI WEIRS

Head in inches	Crest Length (L) 1 foot		2 feet		3 feet		4 feet	
H	GPM	Ac-in/hr	GPM	Ac-in/hr	GPM	Ac-in/hr	GPM	Ac-in/hr
2	101	0.22	202	0.45	302	0.67	404	0.89
3	190	0.42	376	0.83	560	1.24	750	1.66
4	296	0.65	580	1.28	864	1.91	1160	2.56
5	-	-	802	1.77	1196	2.66	1500	3.52
6	-	-	1062	2.34	1580	3.50	2l00	4.64
7	-	-	1350	2.98	2000	4.42	2660	5.88
8	-	-	1638	3.62	2430	5.33	3220	7.14

Arthur W. Selders
State Extension Specialist
Agricultural Engineering