Stream Discharge using the Float-Area Method

The best approach for determining instantaneous stream or ditch flow is to use a current meter (i.e. Flowtracker, Marsh-McBirney, Price AA) in conjunction with the standard USGS discharge measurement methodology (http://pubs.usgs.gov/wsp/wsp2175/pdf/WSP2175_vol1a.pdf) or a properly placed standard weir or flume. In the absence of these two approaches, the float-area method may be used as an approximation of flow. Due to the inherent inaccuracies of this methodology, the field method described below should be followed closely. This method, when performed correctly, may qualify as a professionally documented hydrologic method for comparison to estimation techniques used for physical surface water availability determinations (ARM 36.12.1702(6)). Questions regarding this methodology may be directed towards Mike Roberts or Dave Amman of Montana DNRC's Water Management Bureau.

Float-Area Method

The amount of water passing a point on the stream channel during a given time is a function of velocity and cross-sectional area of the flowing water.

$$Q = AV$$

where Q is stream discharge (volume/time), A is cross-sectional area, and V is flow velocity

You need:

- tape measure
- watch or stop-watch
- rod, yard or meter stick to measure depth
- at least three highly visible buoyant objects such as a drifting branches or logs, pine cone, tobacco container, coffee stir sticks, half-filled bottles, or oranges (objects buoyant enough not to be effected by the wind)
- stakes for anchoring tape measure to stream banks
- waders

Site Selection:

- straight section of stream
- uniform in grade
- minimum surface agitation

Float method – This method measures surface velocity. Mean velocity is obtained using a correction factor. The basic idea is to measure the time that it takes the object to float a specified distance downstream.

Velocity

V = travel distance/ travel time

Because surface velocities are typically higher than mean or average velocities
$V_{mean} = k V_{surface}$ where k is a coefficient that generally ranges from 0.66 to 0.75, depending on channel depth.

Coefficients for Converting Float Velocity to Mean Channel	
Avg. Depth (ft)	Coeff.
1	0.66
2	0.68
3	0.7
4	0.72
5	0.74
12	0.78

Source: USBR Water Measurement Manual (1997)

- Choose a suitable straight reach with minimum turbulence (ideally at least 3 channel widths long).
- Mark the start and end point of your reach.
- If possible, travel time should exceed 20 seconds.
- Drop your object into the stream upstream of your upstream marker.
- Start the watch when the object crosses the upstream marker and stop the watch when it crosses the downstream marker.
- You should repeat the measurement at least 3 times and use the average in further calculations.

Ex. Travel Distance = 50 feet   1st run = 34 sec.
2nd run = 32 sec.
3rd run = 28 sec.
k = 0.7   average run = 31.3 sec.

Velocity = (50 feet / 31.3 sec.) * 0.7 = 1.1 feet/sec.

Area

Area = average width * average depth

Measure stream's width and depth across at least one cross section where it is safe to wade. If possible, measure depth across the stream's width at the start and stop cross sections and average the two but if only measuring one cross section choose the one downstream.

Use a marked rod, a yard or meter stick to measure the depth at regular intervals across the stream. Five depth measurements are typical but more is better, especially in larger streams. Average your cross-sectional areas (A): Using the average area and corrected velocity, you can now compute discharge, Q.

See example below:

Float-Area Method Example

Name:	Roberts
Date/Time:	10/3/2015
Stream/Ditch:	Unnamed Trib.

Discharge (Q) = Velocity * Area

		Upper Cross-Section	Lower Cross-Section
Area (width*average depth)	width (ft) =	11.2	10.3
	depth (ft) =	0.3	0.25
	depth (ft) =	0.5	0.5
	depth (ft) =	0.6	0.6
	depth (ft) =	0.4	0.6
	depth (ft) =	0.2	0.3
	Avg depth (ft) =	0.4	0.45
	Area (W*D) =	4.48	4.64
	Avg Area (sq. ft) =	**4.56**	

Velocity = (travel distance/travel time)*roughness coeff.

	Travel Time (sec)	Travel Distance (ft)	Velocity (ft/sec)
Run #1	32	50	1.6
Run #2	28	50	1.8
Run #3	34	50	1.5
Avg. Time (sec) =	31.3	50.0	
V (avg) =			1.6
Roughness Coefficient k =	0.66		
Velocity (ft/s)=			**1.06**

Q (Discharge)	Velocity * Area	4.8	**cfs**