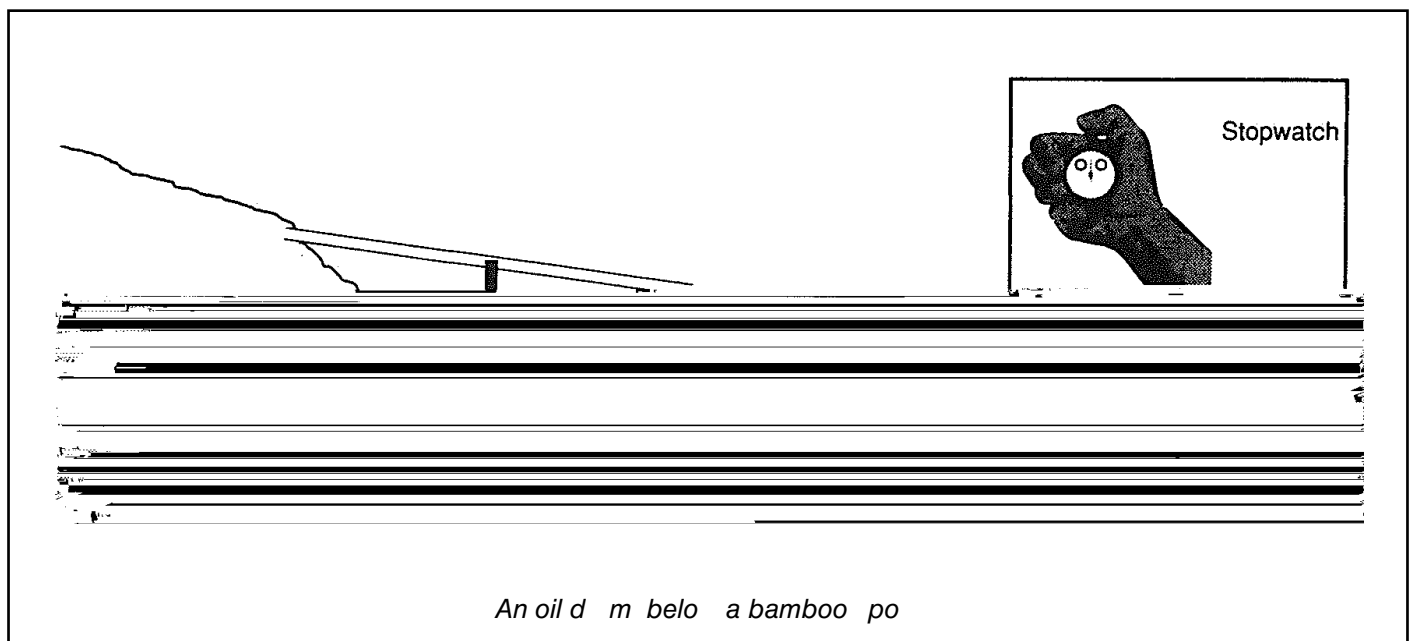


I d c

Community water-supply schemes are generally designed for water consumption in the approximate range of 15 to 60 litres per person per day. Allowance has also to be made for water use by livestock, for future growth in population and demand, and for losses of water by eakage etc. from the system.



Discharge measurements and estimates

Float method

Floats are a simple way of measuring the velocity of a stream, but they are not very accurate. The surface velocity is obtained by measuring the time (t secs) for a float to travel a measured distance (L metres). It is best to choose a straight, uniform river section about 30m long, and to time the float over a number of repeated runs. A piece of fruit makes a good float, as it is less affected by wind than a wooden stick. A factor of about 0.85 should be used to convert surface velocity to average velocity.

$$\text{Surface velocity (m/s)} = L / t$$

$$\text{Average velocity (m/s)} = 0.85 \times L / t$$

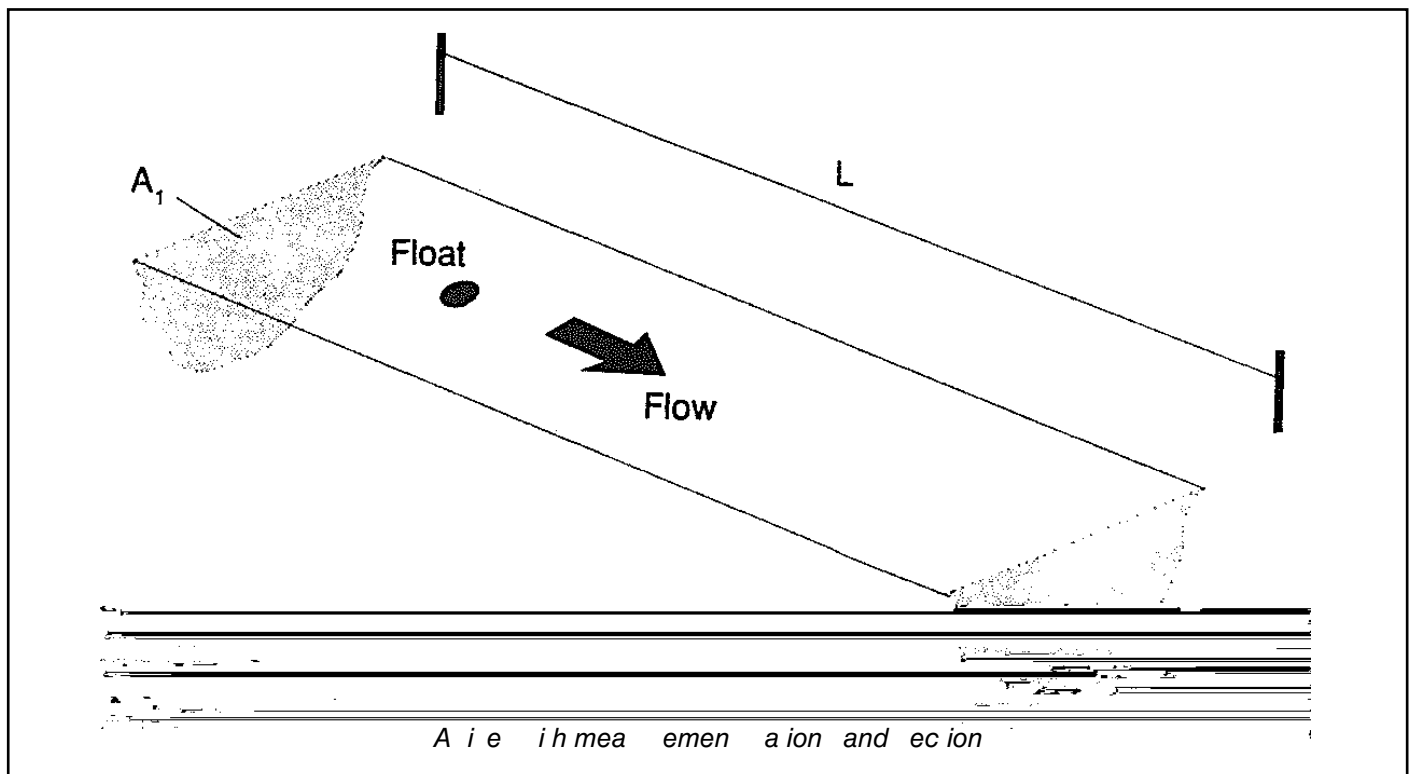
The cross section of the stream should be measured up carefully in a number of places along the test distance, and the average cross-sectional area calculated (A sq m).

Discharge (cubic metres per second)

= average velocity \times cross sectional area of stream

$$= 0.85 \times (L / t) \times A$$

$$\text{Discharge (l/s)} = 1000 \times 0.85 \times (L / t) \times A$$

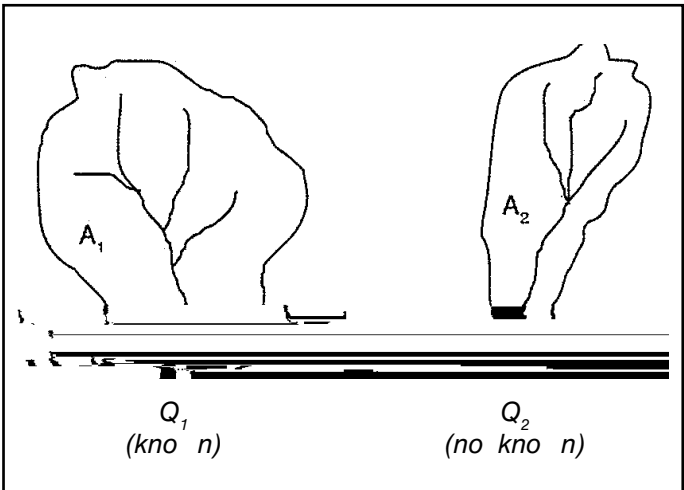
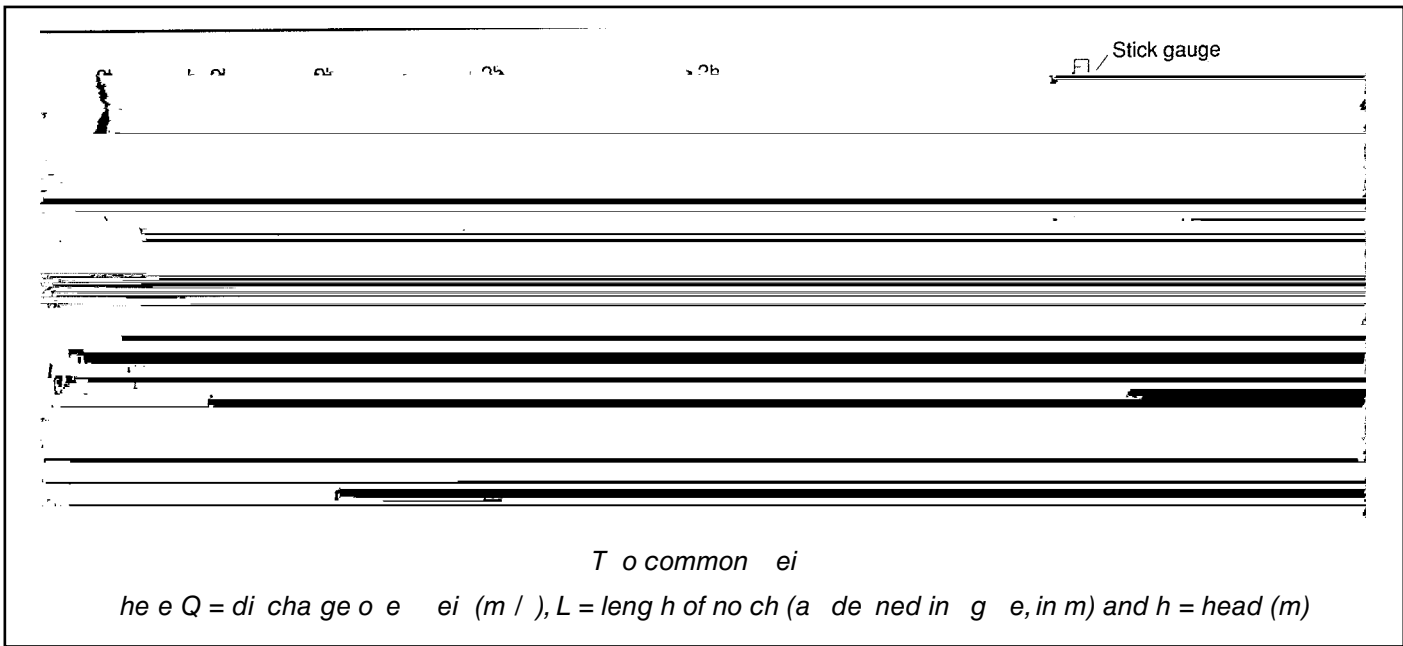


Weir method

Portable weirs made of steel plate can be used for measuring the flow of small streams or springs. They can give accurate measurements, if they are installed carefully. The weir should be set vertically, perpendicular to the stream, and with the crest horizontal. A free fall is required over the weir crest. Leaking must be prevented around the sides of the weir, possibly by using a polythene sheet.

A stick gauge, marked in centimetres, is set vertically at the side of the stream upstream of the weir. It is used to measure the head, h (m), which is the difference between the upstream water level and the crest of the weir. It is important to check that the gauge zero is truly at weir-crest height. This may be done using a spirit level and string line, or water-filled flexible plastic tubing.

There are different shapes of weir, each of which has a standard formula for calculation of discharge. Details for two common weir shapes are given opposite.



- for the recorded basin, measure the catchment area A_1 which drains to the measurement station;
- for the unrecorded basin measure the catchment area A_2 which drains to the point where the flow is to be estimated;
- obtain the dry season flow Q_1 for the recorded basin;
- dry season flow Q_2 (or the unrecorded basin) (deducted from the recorded flow)

Discharge measurements and estimates

d) From local reports (or records) of dry season depth, coupled with survey of the cross section and slope of the stream, and using the Manning equation:

$Q = \frac{A R^{2/3} s^{1/2}}{n}$	Q = discharge (m ³ /s)	suitable values of n are:
	A = area (m ²)	straight river with earth bed: 0.02 - 0.025
	R = A/P where P = wetted perimeter (m)	straight river with stony bed: 0.03 - 0.04
	s = slope (m/m)	straight river with earth bed: 0.03 - 0.05
	n = Mannings roughness coefficient	straight river with stony bed: 0.04 - 0.08

C a d c a e b e e e

T e e a b e e a e d b e e e d :

- Using a V-notch weir set in a steel tank or earth channel
- Using a calibrated orifice plate and pressure gauge on an upstream tapping (the pressure difference across an orifice plate will depend on the flow rate)
- Measuring the co-ordinates of the water trajectory from a horizontal pipe, as shown below.

$$Q = (CAx) \sqrt{\frac{g}{2y}}$$

where C is a coefficient
in range 1.0 to 1.1
for $x > 20, y > 20$
 $g = 9.81 \text{ m/s}^2$

Measurement of flow from a horizontal pipe

Water flow from horizontal pipe (lithic / econd) showing complete flow at the end

F e a :

Cairncross, S. and Feachem, R., *Small scale practice*, Ross Institute Bulletin No. 10, 1978.

Herschy, R. W., *Stream measurement*, Elsevier, 1985.

Text: Ian Smout Illustrations and design: Rod Shaw

WEDC, Loughborough University of Technology, Loughborough, Leicestershire LE11 3TU, UK.