Hydropower Measurement manual

Head & Flow

In order to create electricity from hydropower, two parameters are critical:

- Flow; or the minimum amount of water that is constantly available throughout at least 9 months of the year.
- Head; the difference in height between upper water level and lower water level.

With knowledge of water flow and height difference the potential power can be estimated.

Measuring Head & Flow

The first step to judge a sites hydropower potential is to measure/estimate head and flow.

- Head (the vertical distance between the intake and the outflow of the turbine)
- Flow (how much water comes down the stream)

Head is very often exaggerated as is the flow rate, which varies over the year.
Wrong data occurs frequently. Confirmation of existing data is highly recommended!

Head and flow are the two most important facts of a hydro site. This will determine everything about the hydro system - volume of civil constructions, canal size, turbine size and power output.
Inaccurate measurements can result in lower efficiency, and higher cost.

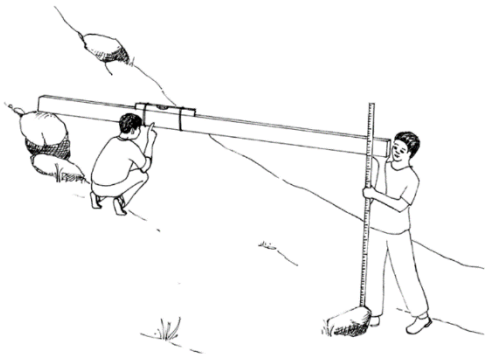
For sophisticated methods how to inquire a sites feasibility, "Layman's book: How to develop a Small Hydro Site" may be a good start.

Simple methods for Head and Flow Measurement

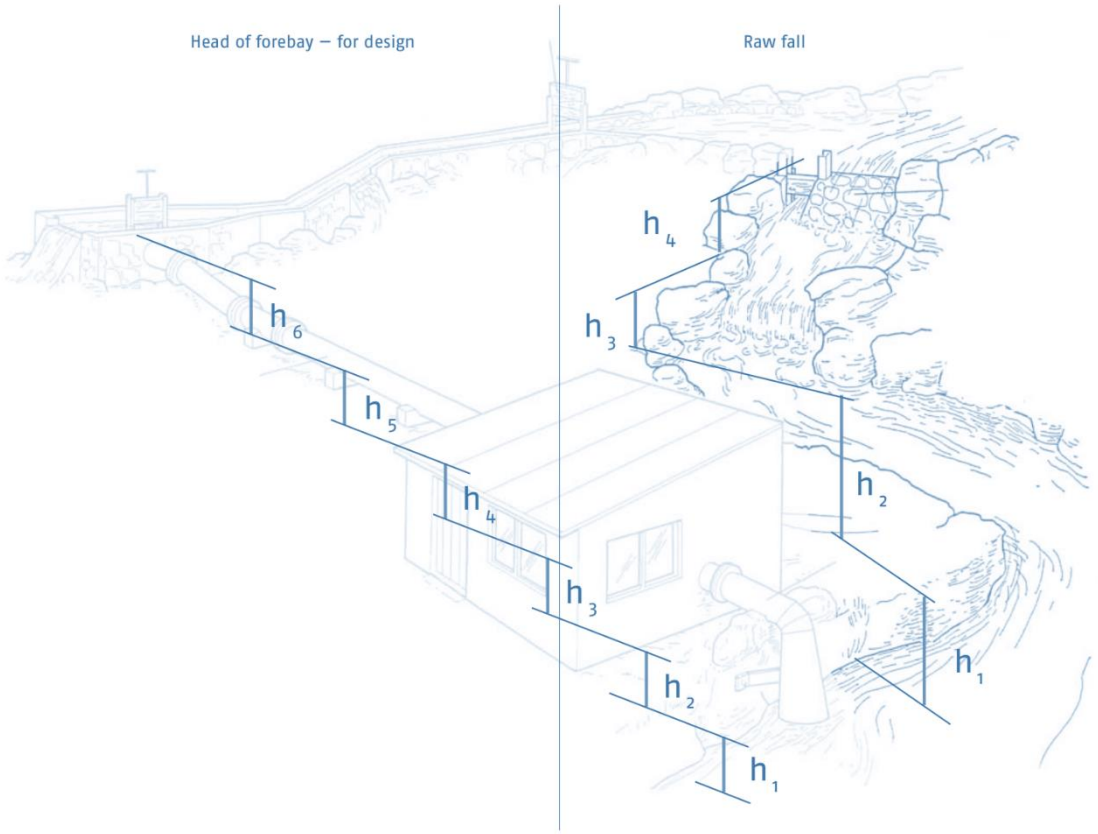
Estimation of height

If detailed maps with contour lines are available or a topographical survey has been done, the gross head can be determined by consulting these aids. Otherwise the following methods can be used to determine the head. You will now measure the height difference between the inlet and the outlet of your future turbine. The following methods can be used:

Spirit level and plank (or string): This is a step-by-step procedure to determine total head H_g between outflow water level and upper water level (at waterfall / inlet), by using a spirit level and plank. When measuring over a longer distance, you measure the height difference in multiple sections (with a distance in between of the length of your plank). You then add them all up using the following formula to reach the total head.



$$H_g = h_1 + h_2 + h_3 \ldots + h_n$$



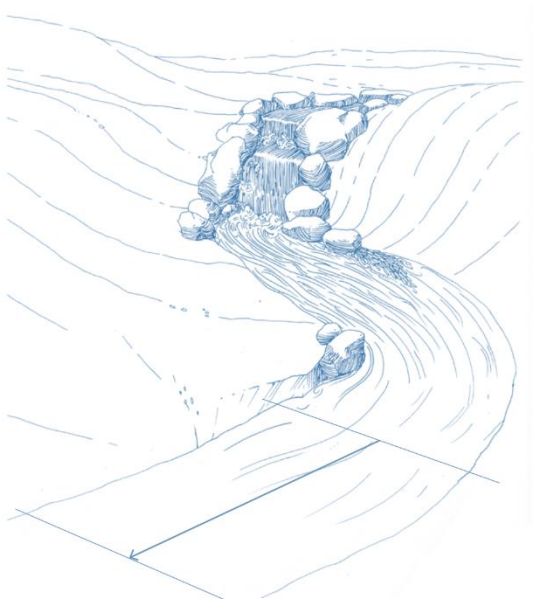
Estimation of flow

A correct estimation of flow is more difficult without special devices, however, there is a very easy method to do a rough estimation. This will quickly show you if your site is suitable for our turbines.

Float method:

Procedure:

- locate an evenly flowing area of water of a certain length *L* [m] where there is almost no turbulence.
- Determine the area's cross section by measuring *B* [m] and *H* [m]: $A = B \times H$
- In order to determine velocity *V* [m/sec] measure the time *T* [sec] it takes for a float to travel the above determined length *L* (allow floats to accelerate before the start), then divide length *L* by time *T*. $V = L / T$
- to determine the flow *Q* multiply velocity *V* by cross-sectional area *A*. $Q = V \times A$



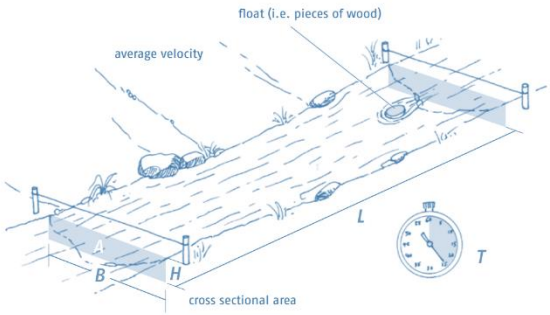


Illustration explaining the velocity-area method

Example:
A ball drifts 10 m in 20 s → speed = 10m/20s = 0.5 m/s.
Cross section → A= 5 m x 0.5 m = 2.5 m^2
Flow volume → 0.5 m/s x 2.5 m^2 = 1.25 m^3/s = 1250 l/s

With thanks to Energypedia and GTZ for the source materials.