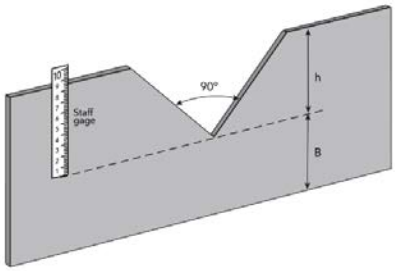
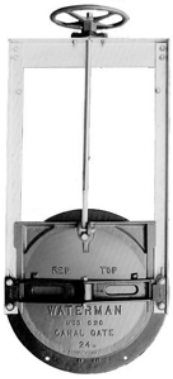
Measuring Flow in Open Channels

- Weirs
- Flumes
- Standard Canal Metergates
- Non-standard Canal Structures



Weir Plate

Flume



Canal Gate

Standard metergates, weirs and flumes are common devices installed in open channels and irrigation ditches to measure water flow. Each has advantages and disadvantages and understanding these can help you decide which one to choose. The choice of which device to use will depend on channel size, range of flow rates and flow gradient. Flow measurement structures should be installed near the point of diversion.

The basic considerations in choosing a flume or weir is whether the device can handle the range of expected flow rates in the channel, and selecting the most economical device that fits the channel geometry. When selecting a measuring device, be aware that all devices have a minimum flow rate below which their accuracy and usefulness are questionable. Each device has its own rating curve or rating table that correlates various depths of water (by reading the staff gage on the device) with the quantity of water flowing through the flume or over the weir.

Weirs can be low cost and the installation of the weir plate is generally easy. Installation costs for flumes tend to be higher than those for weirs. When in doubt, reach out to knowledgeable manufacturers for additional information.

Weirs

Thin-plate weirs are one of the simplest, least expensive, and most common devices used to measure open channel flow. A thin-plate weir is essentially an obstruction built across an open channel which causes water to back-up, creating a pool of water (head) behind the barrier. Water flows over the barrier through a specially shaped opening or notch. While the installation of the actual weir or weir plate can be relatively simple, this is not always the case for the upstream weir pool. A weir pool is a body of water upstream of the weir itself that serves to condition the flow as it approaches the weir itself.

Weirs are normally classified by the opening/notch shape. Common types of weirs are, V-notch, rectangular and trapezoidal. Each opening/notch shape type has a discharge equation specific to it.

Weirs can require more maintenance than flumes because sediment and debris can collect behind the weir plate and can, over time, change the shape of the weir pool, which will adversely affect accuracy. Built correctly and properly maintained, weirs provide a simple, reliable method for water measurement.

Flumes

Flumes are specially shaped, fixed hydraulic structures that force flow to accelerate through an opening that can be measured. A flume normally consists of a three sections: a converging section, a throat section, and a diverging section.

Flumes range in size from small to the very large, with throat widths ranging from 1-inch to 50-feet. Measurable flows can range from 0.03 to 3,000 cubic feet per second (ft^3/s). With a variety of cross-sections available, flumes can be readily integrated into trapezoidal irrigation channels, round pipes and rectangular channels. Examples of this configuration include: Parshall, Trapezoidal and Cutthroat flumes.

Standard Canal Metergates

Standard metergates and orifices have published flow tables that correlate water level measurements with flow rates. Guidance for installing standard open channel devices can be found in the *"Flow Measurement & Calibration Section"* of the Water Management Planner published by the Bureau of Reclamation.

References:

- Irrigation Training & Research Center, Cal Poly
- Water Management Planner, USBR

Non-standard Canal Structures

Non-standard devices do not have published flow tables for calculating discharge, unlike standard metergates. One alternative to installing a new metergate is to calibrate existing canal structures, or develop a stage-discharge relationship for the channel using a velocity meter. Acoustic meters are another option for measuring channel flow. Guidance for calibrating non-standard structures can be found in the "*Flow Measurement & Calibration Section*" of the Water Management Planner published by the Bureau of Reclamation. A professional specializing in flow measurements should be consulted to calibrate existing in-channel flow structures.