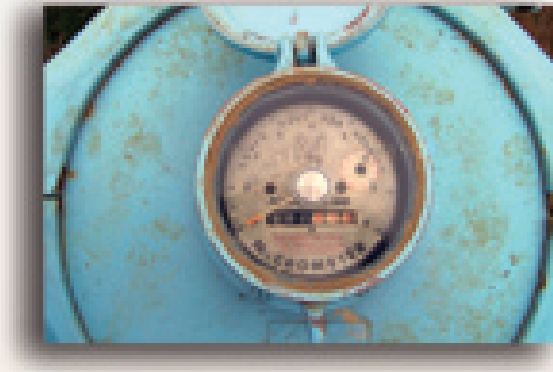


VII. Know How Much Water Has Been Pumped

Section VII covers the importance of measuring water flow. You cannot manage water if you do not measure it. Even if you use the methods presented in Section VI to determine how much water to pump, if you do not have a way of measuring actual water flow how will you know if you managed the system correctly?

This section discusses flow meters and the requirements for installation. Ag pumpers should realize that water flow can be measured in ditches as well as pipelines.



Flow Meters

What Does a Flow Meter Measure?

Water flow meters (flow meters or meters) can measure the flow rate of water or the total water that has passed by the measuring point. Many meters will do both.

Instantaneous reading is a term used for meters that measure flow rate.

Totalizer is a term used for meters that measure the total volume of water.

Flow rate is the volume of water per unit of time moving past the measuring point. Typically flow rates are measured in either gallons per minute (gpm) or cubic feet per second (cfs).

Total volume readings may be in either gallons or acre-feet of water (one acre-foot of water equals 325,851 gallons).

Measure Flow Rate or Total Volume of Water?

Each measurement is important for managing an irrigation system. Flow rate is the type of information often used to help verify that pressurized irrigation systems (i.e. sprinkler or micro-irrigation systems) are operating correctly. Flow rate also is important in judging pumping plant efficiency.

Total volume readings are used in irrigation scheduling methods that use a water balance approach. They serve as a check on how much water was actually pumped to a field versus what you thought you needed. They also are used by water supply or drainage agencies to measure total water volume moving onto or off farms.

Why is Flow Rate Important to Energy Savings?

It requires energy to power a water pump and energy is costly. A flow meter can help identify pump, well, and irrigation system problems before a failure occurs. In drip and micro-irrigation systems, catastrophic problems due to plugging or pipeline/hose breaks can be detected and corrected before crop loss or flooding occurs. Keeping records of flow meter readings can indicate when a pumping system is deteriorating. Thus, meters can help you maintain highly efficient hardware in the field.

However, energy-efficient hardware is of little help in reducing energy costs if it is run longer than needed. Flow measurement will help you judge how long you need to run the pump.

Why is Flow Measurement Important to Water Savings?

You need to measure water to manage water. Efficient and effective irrigations deliver the right amount of water at the right time, spread evenly across the field. Thus, it is important to know how much water is required for each irrigation. However, if you do not know how much water is actually applied during an irrigation you will not know how efficient it was or whether you need to improve.

If you are using a pressurized system such as a sprinkler or drip system, there is a design flow rate for that system. A flow meter can identify if the right amount of water is moving through the system. A meter with a totalizer will indicate how much water was applied per irrigation and can help judge how closely the irrigations met water management objectives.

Doesn't a Pump Test Give Me the Flow Rate?

A pump test does measure flow rate but only gives a snapshot of pump flow at **one** point in time. A flow meter will provide a measurement at any given point in time. Periodic measurements should be recorded to track your pump performance history. This is especially important with water wells where wear from sand or declining water tables can substantially impact pump performance over time.

How Much Does a Flow Meter Cost?

Flow meters range in cost from \$150 each for simple models to highly-sophisticated electronic meters of several thousand dollars each. Typical propeller saddle meters range in cost from \$600 to \$1,000. However, the cost of flow meter installations may be increased significantly if major modifications have to be made to allow for accurate measurements.



IMPORTANT!

Although sometimes a substantial investment, the cost of a flow meter should be compared to the total cost of the pumping system and the annual cost of operating that system. Accurate flow measurements can pay for themselves many times over with decreased water and energy costs and potentially higher yields due to improved irrigation management.

What is Used to Measure Flow Rate?

There are many different ways to measure water flow in pipelines. The most commonly used flow meter in agriculture is the propeller type (*Figures VII.1 and VII.2*), mounted as a saddle on a pipeline or inserted as a section of the pipe.

Other common types of meters used in pipelines are the Venturi type (*Figure VII.3*) and the paddle wheel type (*Figure VII.4*). Pump efficiency testers will often use a manometer (*Figure VII.5*).

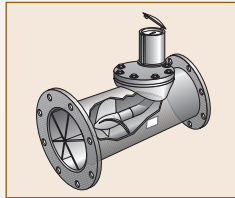


FIGURE VII.1 -
*Propeller-type flow meter
inserted in-line*



FIGURE VII.2 -
*Meter in
pipe section mounted in a
sprinkler system show
portability*

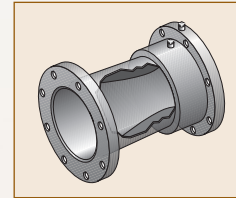


FIGURE VII.3 -
Venturi type

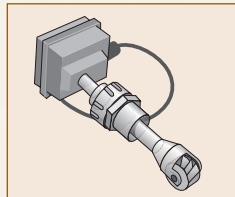


FIGURE VII.4 -
Paddle wheel



FIGURE VII.5 -
Manometer setup

Each of these methods has advantages and disadvantages. Consult with knowledgeable people in your area for the best device for your situation. You may want to talk to your local pump dealer, water district, irrigation system designer/installer, or UC Cooperative Extension agent.

Can I Measure Water in Ditches?

Yes. Most people think of flow meters in terms of the common propeller type installed in pipelines. However, measuring water flow in ditches and canals is quite common. It is even possible to measure flow in a single furrow. Some common ways of measuring water are the overflow weir (*Figure VII.6*), the meter gate (*Figure VII.7*), orifice plates, and various types of flumes.



FIGURE VII.6 -
Overflow weir

Are Flow Meters Portable?

Yes. Many types of flow meters can be made portable, for both pipelines and canals and ditches. This allows the use of one flow meter on different pumping systems, thus, saving money. You should maintain written records of meter readings for each system.

IMPORTANT!

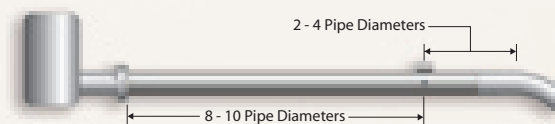
Whenever using a portable water meter, make sure that it is calibrated to the particular installation. For example, do not use a flow meter calibrated for a 6-inch pipeline in an 8-inch pipeline.



FIGURE VII.7 -
Meter gate

Correct Installation in Pipelines

Traditionally it is recommended there be at least 8-10 diameters of straight pipe upstream of a meter and 2-4 diameters downstream of any obstruction in a pipe (elbow, valve, pump discharge head, etc.). Obstructions create turbulent water conditions which make measurement difficult or impossible. For example, a 6" discharge pipe would require 6 times 8 which equals 48" or 4' of straight pipe before the measurement point.



Sometimes straightening vanes can be added that will allow reasonably accurate measurement within less than 8-10 pipe diameters of an obstruction. **Always check the manufacturer's recommended specifications for an accurate installation.**

Correct Installation in Canals and Ditches

Flow measurement in open channels requires a certain amount of head loss (*reduction in the overall elevation of the water flow*). Thus, there must be enough freeboard (*distance from the top of the flowing water to the top of the channel banks*) to accommodate this loss. Care must be taken in choosing the method and designing the installation of a flow measuring device in an open channel. However, some types of flumes, especially the trapezoidal flume, require very little head loss. Also, as with pipelines, water flow into the measurement section should be straight and smooth.

IMPORTANT!

Whenever installing a flow meter, either in pipelines or an open channel, consult with a qualified pumping specialist or engineer to ensure that the installation will result in accurate measurements.

Flow Meter Maintenance

As with other mechanical devices, flow meters require routine maintenance and inspection. When your flow meter is installed, always ask about normal maintenance and inspection procedures and make sure to get a copy of any owner's manual that is available for your particular meter. Follow the manufacturer's recommended maintenance routine to make sure your flow meter is operating at its optimum level of performance.

Some things to watch for:

- Most flow meters operate very quietly. Noise is often the first sign that a failure may be near - listen for any sounds that would indicate binding or worn gears.
- Visual clues of poor flow meter operation include an unsteady flow rate indicator (indicating binding or worn gears or possibly a pipe that is not running full) or fogging of the lens (leak in the bearing assembly or external seal).
- Open channel flow measuring devices also should be properly maintained. Weirs and flumes should be level, permanent measuring staffs should be set at the correct levels, and trash should not be allowed to collect upstream of an overflow weir.

In Summary

Water flow measurement is essential to water and energy management. A flow measurement can indicate whether a pumping system or an irrigation system is operating correctly. Thus, they help you to maintain highly efficient equipment in the field. They also help you manage that equipment to minimize energy and water use. Contact the Program for more information on flow measurement.