Measuring Pump Flow Rates

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Measuring Irrigation Water Flow Rates

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Measuring Flow:

- Why would you want to do it?
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  - Critical for irrigation scheduling. You need to know how much you’re applying.
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  - Can help determine if there is clogging occurring in a drip system.
Measuring Flow:

- Why would you want to do it?
  - Critical for irrigation scheduling. You need to know how much you’re applying.
  - Can help determine if there is clogging occurring in a drip system.
  - Keep track of the amount of water applied.
Flow Measurement:

- Terms:
  - Flow = volume of water (gallons, cubic feet, acre-ft, etc.)
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- **Terms:**
  - Flow = volume of water (gallons, cubic feet, acre-ft, etc.)
  - Flow rate = volume of water per unit time
    - gallons per minute (gpm), cubic feet per sec (cfs)
Flow Measurement:

- Terms:
  - Flow = volume of water – gallons, cubic feet, acre-ft, etc.
  - Flow rate = volume of water per unit time
    - gallons per minute (gpm), cubic feet per sec (cfs)

If you know the flow rate and the time of operation, you can get the flow (volume pumped).
Using flow meter readings:

- Flow meters give you applied water in a volume (gallons, cubic feet, ac-ft, etc.) and/or a flow rate (gal/min, cfs, etc.)

vs.

- Irrigation scheduling info. is in terms of “inches” of water use (e.g. in/day).
Using flow meter readings:

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  vs.

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\[
\text{Depth of Applied Water} = \frac{\text{(Flow Rate} \times \text{Time})}{\text{(449} \times \text{Area})}
\]

Note: 1 cfs = 449 gpm
Using flow meter readings:

- Flow meters give you applied water in a **volume** (gallons, cubic feet, ac-ft, etc.) or a flow rate (gal/min, cfs, etc.)

  vs.

- Irrigation scheduling info. is in terms of “inches” of water use.

\[
\text{Depth of Applied Water} = \frac{\text{Flow volume}}{\text{Area}} \div 3630
\]

\[\text{Depth of Applied Water} \quad (\text{inches}) \quad \frac{\text{Flow volume}}{\text{Area}} \quad \div \quad 3630 \quad (\text{acres})\]

Note: 1 cubic ft = 7.48 gallons
Using flow meter readings:

Translating ET (in/day) to vine use (gal/day)

\[
\text{Vine Water Use} = \text{ET} \times \text{Vine spacing} \times 0.623
\]

(gal/day) (in/day) (ft²)
Measuring Flow from a Pump:

- Can be done with:
  - Pump Test
  - Flow meter
Pump Test:

- What is done during a pump test?
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800 hp pump
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What is done during a pump test?

- Measurements of flow rate, pressure, and power input are taken.
- Flow rate measurements are usually taken with a pitot tube flow measurement device (Hall Tube or Collins Tube).
  - Can be quite accurate but need a straight section of pipe upstream (8 to 10 pipe diameters) to get best readings.
Pump Test:

- What should you watch for if you’re going to use the pump test flow rate provided to you?
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  - Pump should have been tested under the conditions you will be using it.
  - Over time, pumps wear (that changes flow rate, efficiency, etc.) and pumping levels may change.
Pump Test:

- To get Total Flow, use the flow rate (gpm) and an accurate measure of operation time.
Flow Meters

- All flow meters are measuring the **velocity** of water flow.
- To be accurate, the pipe needs to be flowing **full**.
Flow Meters

- All flow meters are measuring the velocity of water flow.
- To be accurate, the pipe needs to be flowing full.
- If we know the flow velocity & the inside pipe diameter, we can determine the flow rate (e.g. gal/min)
Flow Meters

- Installation
  - Important to measure at a location where there is minimal turbulence.
Flow Meters

Installation

- Important to measure at a location where there is minimal turbulence.
- Measure in straight section of pipe
  - Standard is 8 to 10 pipe diameters of straight pipe upstream, 3 to 5 pipe diameters of straight pipe downstream.
Flow Meters

**Installation**

- Important to measure at a location where there is minimal turbulence.
- Measure in straight section of pipe.
- Don’t measure downstream of fittings causing turbulence (partially closed valves, elbows, tees, etc.)

`CA Agriculture article on the affect of water turbulence on flow meters` 
http://californiaagriculture.ucanr.org/landingpage.cfm?article=ca.v052n01p25&fulltext=yes
Flow Meters

- What types are commonly used in agriculture?
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  - Propeller Meters:
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- What types are commonly used in agriculture?
  - Propeller Meters:
    - How they work.
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    ▪ How they work.
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    - Readouts frequently display flow rate and totalized flow.
Flow Meters

What types are commonly used in agriculture?

Propeller Meters:
- How they work.
- Must be sized for the pipe installed in or will not be accurate!
- Readouts frequently display flow rate and totalized flow.
- No power required.
Flow Meters

- What types are commonly used in agriculture?
  - Propeller Meters:
    - How they work.
    - Must be sized for the pipe installed in or will not be accurate!
    - Readouts frequently display flow rate and totalized flow.
    - Very good for clean water but not good if debris in water.
Flow Meters

What types are commonly used in agriculture?

Propeller Meters:

- How they work.
- Must be sized for the pipe installed in or will not be accurate!
- Readouts frequently display flow rate and totalized flow.
- Very good for clean water but not good if debris in water.
- Cost.
Flow Meters

- What if your water is not clean?
Flow Meters

- Electromagnetic Flow Meters
  - Very accurate but more expensive. Will handle dirty water easily.

Tube Magmeter
Flow Meters

- **Electromagnetic Flow Meters**
  - Very accurate but more expensive. Will handle dirty water easily.
  - How does it work?

Here’s How It Works...

Induced Voltage = BxDxV^1

- B = Flux Density (magnetic strength)
- D = Diameter of Conductor
- V = Fluid Mean Velocity
Flow Meters

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  - How does it work?
  - What kind are available?

Tube Magmeter

Insertion Magmeter
Flow Meters

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  ▪ How does it work?
  ▪ What kind are available?

▪ Advantages:
  ▪ Very accurate
  ▪ Low maintenance
  ▪ Handles all qualities of water
  ▪ Less susceptible to turbulence (tube magmeters)
Flow Meters

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- How does it work?
- What kind are available?
- Advantages:
  - Very accurate
  - Low maintenance
  - Handles all qualities of water
  - Less susceptible to turbulence

Disadvantages:

- Cost
- Requires power.

SeaMetrics  [www.seametrics.com/](http://www.seametrics.com/)
Flow Meters

- Doppler Flow Meters
  - How are they used?
Flow Meters

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  - How are they used?
  - How do they work?
Flow Meters

**Doppler Flow Meters**
- How are they used?
- How do they work?

**Advantages**
- Very portable and easy to use.
- Little maintenance
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  - How are they used?
  - How do they work?
- **Advantages**
  - Very portable and easy to use.
  - Little maintenance
- **Disadvantages**
  - Not as accurate as propeller or magmeters.
  - Need some particles in the water.
  - Requires power.
Flow Meters

- Paddle Wheel Flow Meters
  - Inserted through a threaded saddle into the pipe.
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- **Advantages:**
  - Inexpensive, especially for large pipe diameters.
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  - Inserted through a threaded saddle into the pipe.
  - Spin of the paddle wheel is function of water velocity.
- **Advantages:**
  - Inexpensive, especially for large pipe diameters.
- **Disadvantages:**
  - Not as accurate, especially if there is turbulence.
  - Maintenance issues.
Flow Meters

- New Developments:
  - Data logging available on many, if not all, flow meters.
Flow Meters

**New Developments:**

- Data logging available on many, if not all, flow meters.
- Some manufacturers are even going to satellite / web based reporting.
  - You can just go to a web site and see the flow vs. time record for each of your flow meters.
Questions???

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