Flow Meter Use on Dairies

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Thanks to Noelia Silva and UC Cooperative Extension - Tulare County for hosting today’s meeting.
Powerpoint Presentations with Narration

- Units and Measures of Irrigation Water
- What is Irrigation Efficiency
- What is Irrigation Uniformity
- Measuring Applied Irrigation Water
- How Much Water Should Be Applied?
- Tailwater Return Systems
- Basics of Surface Irrigation
- I’m Applying Too Much Water, What Can I Do?
- Why Do I Need To Be a Good Water Manager?
Measuring Irrigation Water Flow Rates

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University of California
Agriculture and Natural Resources
Publication 21044
Funded by the Joseph G. Prosser Trust
Administered by the University of California
Water Resources Center
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Why do I need to know my flow rates?
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Flow Meter Use on Dairies

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Flow Meter Use on Dairies

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http://www.cdqa.org/binder.asp

“Calculating Nutrient Application from Liquid Manure Irrigations”
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- Want the N calculations in lbs. of N per acre
  - For well water: \( \text{NO}_3-N \times 2.73 = \text{lbs. N per ac-ft of water} \)
  - For manure water: a little more complicated because of nitrogen in ammonium and organic forms.
- You HAVE to know the VOLUME of water applied to make the “Applied N” calculation
Flow Meter Use on Dairies

- Why do I need to know my flow rates?
  - The requirement is that you are to apply no more Nitrogen than 1.4 times the Nitrogen removed in the crop.
  - We also use the flow meter info. to check the irrigation efficiency.
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    - If there is nitrate present in the soil, the drainage water will leach nitrate from the root zone.
      - Bad for groundwater
      - Nitrogen no longer available for crop use = Under-fertilization
Flow Meter Use on Dairies

- Which flows do you need to measure?
Flow Meter Use on Dairies

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  - Freshwater flows
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Flow Meter Use on Dairies

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Schwankl Water Management Rule of Thumb

*If it’s hard to do, it probably won’t get done.*

*If it’s easy to do, it might get done.*
Flow Meter Use on Dairies

- How do you measure the flow rates?
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  - What kind of flow meter?
Flow Meter Use on Dairies

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    - Electromagnetic meter (Magmeter) – nothing to clog up
Flow Meter Use on Dairies

As California’s dairy industry continues to grow, manure management has become an increasingly important issue for dairy producers, government regulators, and the public living in close proximity to dairies. Dairies are increasingly required to prepare nutrient management plans and comply with regulations concerning their manure management practices. A common dairy practice in California is to house the cows in free stall barns with water flush systems to remove the manure. The manure flush water, high in nutrients such as nitrogen and phosphorus, is collected in holding ponds until it can be combined with freshwater and applied to cropland during irrigation. Being able to quantify the amount of manure water applied is critical to good nutrient management of crops. The high trash and debris content of manure water has precluded the use of most flow meters commonly used in agriculture, such as the propeller meter. A field test of electromagnetic flow meters and a Doppler flow meter determined that both were accurate, dependable and appropriate for measuring manure-water flow rates. Their drawbacks are price ($3,000 to $4,000) and the need for electrical power for permanent flow-meter installations.

There are approximately 2,200 dairies in California, with more than 1.4 million cows. The largest concentration of dairies is in Southern California (Riverside and San Bernardino counties) and in the San Joaquin Valley (Tulare County north to San Joaquin County). Dairy size is continually increasing, resulting in ever-larger volumes of manure that must be managed. Many dairies use a free stall barn system that is flushed with water to remove manure and collect it in a holding pond. Other dairy water (such as holding pen/milking parlor water or steam-wax water runoff) that comes in contact with manure is also collected and stored in the manure pond. The manure-pond water, which is rich in nutrients, is mixed with freshwater and applied to agricultural fields during irrigation. The objective is to apply the nutrients in agronomically appropriate amounts and, in doing so, manage the amount of nitrogen and phosphorus that might eventually pollute groundwater.

Successful nutrient management of dairy manure-pond water applied to fields requires knowing both the flow rate from the pond and the nutrient content of the pond water. Pond water must be sampled to determine nutrient concentrations. Sampling is most easily done at the pond’s discharge pipe, either with a sampling valve inserted into the pipe or as the water enters a stand-pipe prior to being mixed with fresh water and sent to the fields for irrigation. Water quality may vary by season and by pond depth, so sampling should be done appropriately to characterize the manure water.

Obtaining flow-rate measurements for manure water can be challenging. The current draft guidelines for Comprehensive Nutrient Management Plans (CNMPs), developed by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) and the U.S. Environmental Protection Agency, emphasize the importance of accurately measuring manure-water applications (NRCS 2003). CNMPs are required by the NRCS for cost sharing on some dairy improvements. In addition, Merced County is requiring that all of its dairies (135 in 2003) complete CNMPs by 2006 (Merced County 2003). Other Central Valley counties are also considering requiring CNMPs for dairies. In addition, revisions to federal and state water-quality regulations may mandate nutrient management plans in the near future.

Dairy operators often do not measure flow rates for their manure-pond water.
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- What kind of flow meter?
  - Propeller flow meter
  - Electromagnetic meter (Mag meter) – nothing to clog up
  - Doppler meter – portable but not as accurate
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Magmeter best choice
Flow Meter Use on Dairies

How do you measure the flow rates?

- Manure water – you could use pond drop but a flow meter is the only good choice.
- Freshwater sources.
  - Wells – could use pump test info. but what if well flow rate is changing?
    - Dropping groundwater table, pump wear, etc.
    - Have to keep track of time of operation.
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  ▪ What kind of flow meter? Either a propeller meter or a mag meter will work fine.
    ▪ Propeller meter: nothing to clog it up, less expensive, but may require more maintenance to stay accurate.
    ▪ Magmeter – more expensive, slightly more accurate, less maintenance.
Flow Meter Use on Dairies

- Flow Meters:
  - How are they installed?
Flow Meter Use on Dairies

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How are they installed?

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- Some electromagnetic meters are partially portable – installed through a fitting in side of pipe.
- Propeller meters can be bolt-in via flanges or saddle meters.
Flow Meter Use on Dairies

Flow Meters:
  - How are they installed?
  - Where should they be installed?
Flow Meter Use on Dairies

- Flow Meters:
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  - Propeller meters: 8-10 pipe diameters of straight pipe upstream of meter. 4-5 pipe diameters of straight pipe downstream of meter.
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    - Install in straight section of pipe:
      - Propeller meters: 8-10 pipe diameters of straight pipe upstream of meter. 4-5 pipe diameters of straight pipe downstream of meter.
      - Magmeters: follow manufacturer’s recommendations but straight pipe sections are usually less for magmeters than for propeller meters.

Install a sampling tap when installing the meter!
Flow Meter Use on Dairies

- Flow Meters:
- Other flow measurement situations:
Flow Meter Use on Dairies

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  - Water is in a channel, ditch, etc. = Open Channel Flow
    - Harder to measure, harder to measure accurately.
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Estimations using Trajectory Method

![Diagram of Flow Meter Use on Dairies](image)
Flow Meter Use on Dairies

- Flow Meters:
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  - Measuring open channel flow:
    - Flumes – can pass debris, hard to build
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▪ Measuring open channel flow:
  ▪ Flumes – can pass debris, hard to build
  ▪ Weirs – easier to build, traps debris
  ▪ Siphons

Figure 40. Measuring the head of siphons. The head is the difference between the elevation of the water surface in the ditch and the water surface in the field.

Rate of flow through small siphons

<table>
<thead>
<tr>
<th>Head (H) inches</th>
<th>Gallons per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 in.</td>
<td></td>
</tr>
<tr>
<td>2½ in.</td>
<td></td>
</tr>
<tr>
<td>2 in.</td>
<td></td>
</tr>
<tr>
<td>1½ in.</td>
<td></td>
</tr>
<tr>
<td>1 in.</td>
<td></td>
</tr>
<tr>
<td>¾ in.</td>
<td></td>
</tr>
</tbody>
</table>

Figure 41. Chart showing the rate of flow through small siphons for different head heights.
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**Flow Meter Use on Dairies**

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    - Flow meter readings at beginning and end of irrigating a field.
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    - Manure water application may vary
    - May give you info. on how to manage your manure water better.
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Consider getting flowmeters with data loggers

- Can always go back and check flow meter readings
- Irrigators may then only need to keep track of WHEN sets are changed
Questions???

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Powerpoint available at: http://schwankl.uckac.edu
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