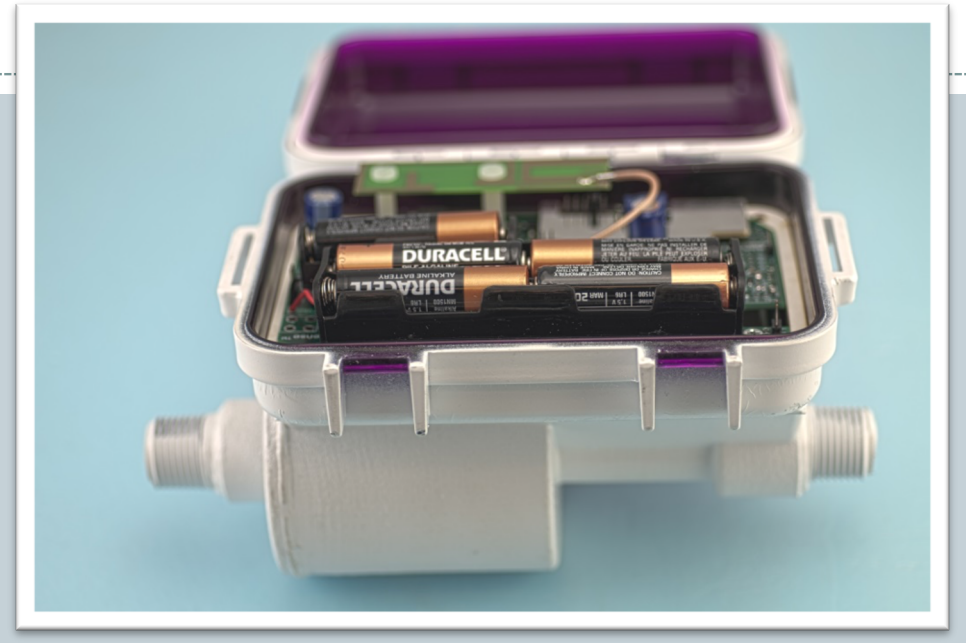
The Application of SWEETSense™ Technology on the Ram Pump Project



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PORTLAND STATE UNIVERSITY REU

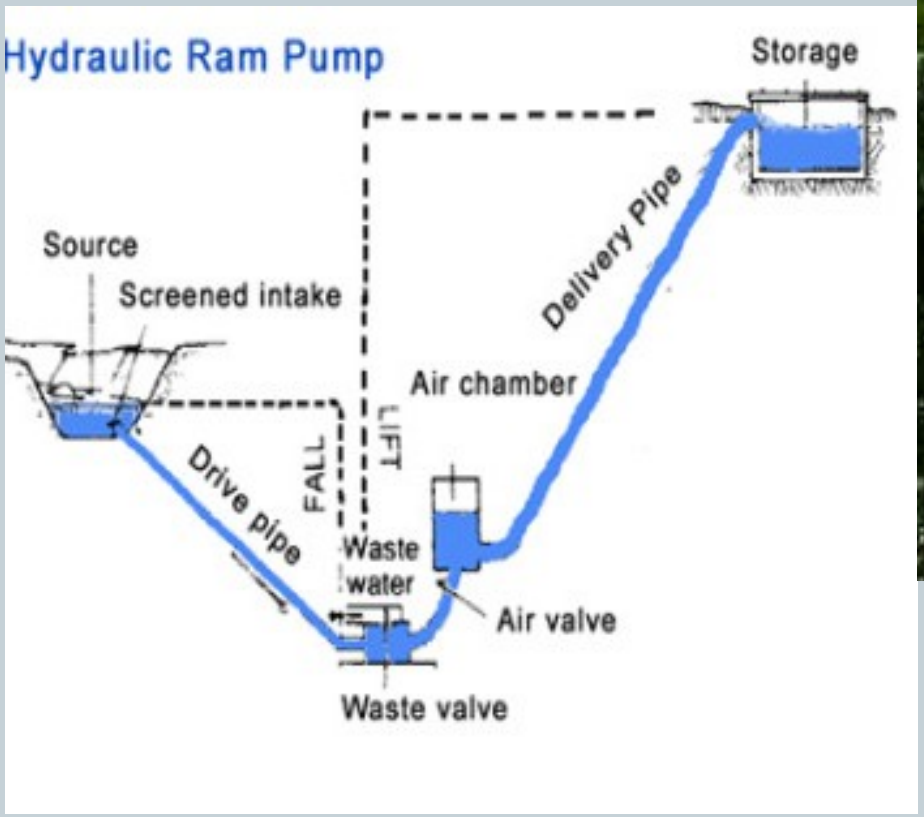
SWEETLAB™

SWEETSense™ Technology

Some SweetLab™ Projects

- Tippy Tap
- Cook Stoves
  - Monitor efficiency and usage
- Hand Pumps
  - Monitor proper functioning and usage
- Water Sanitation Testing
  - Monitor water testing results and GPS

Ram Pump


Hydraulic Ram Pump
Storage
Source
Screened intake
Delivery Pipe
Air chamber
LIFT
FALL
Drive pipe
Waste water
Air valve
Waste valve

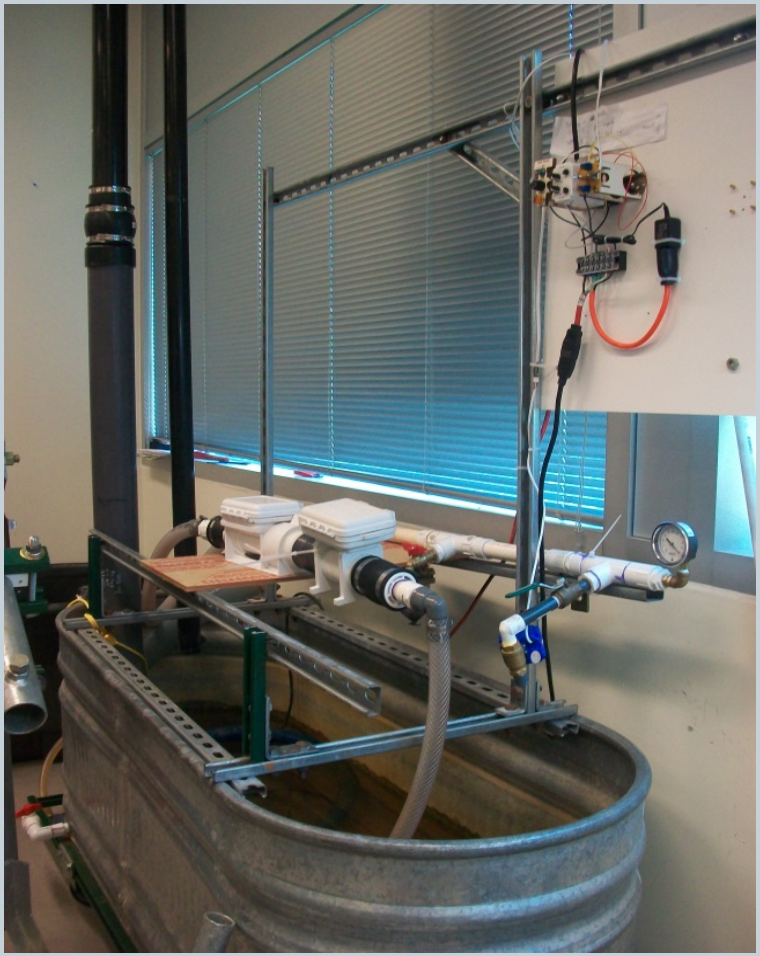
What we currently know

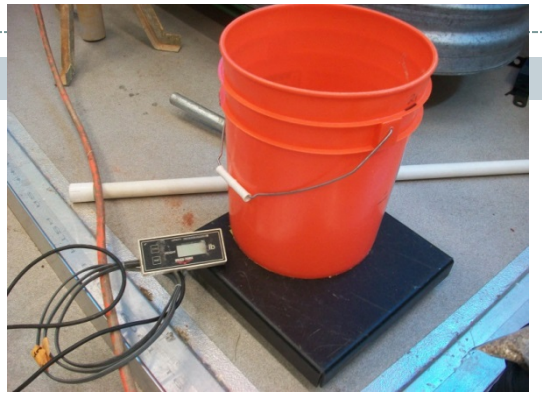
- If it's being used
- How often it is being used
- How long is it being used for each day/month/year

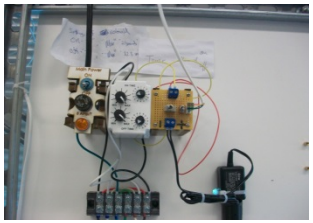
What we want to know

- How much water is being used?
- What is the water demand for these communities?
- Is this Ram Pump sufficiently supplying communities?
- What can be done to improve access to clean water?

Flow Meter Testing Setup

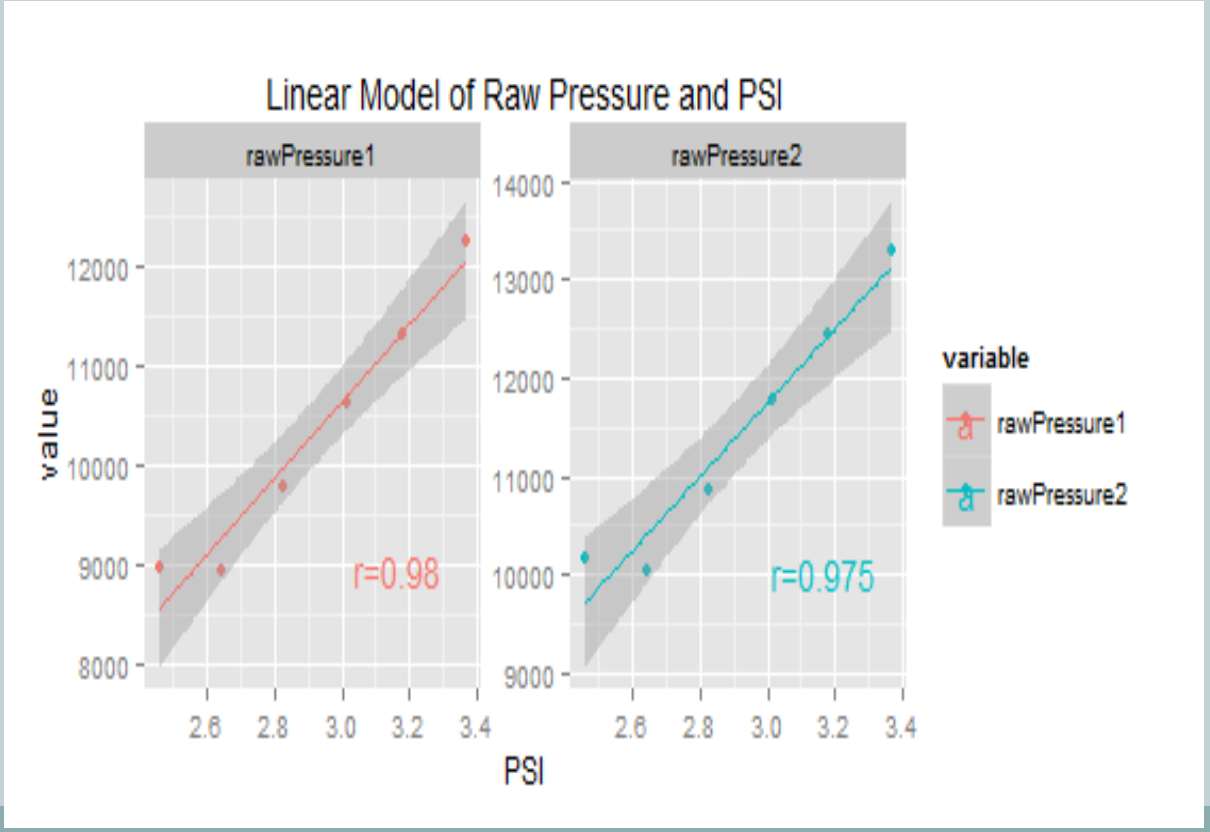






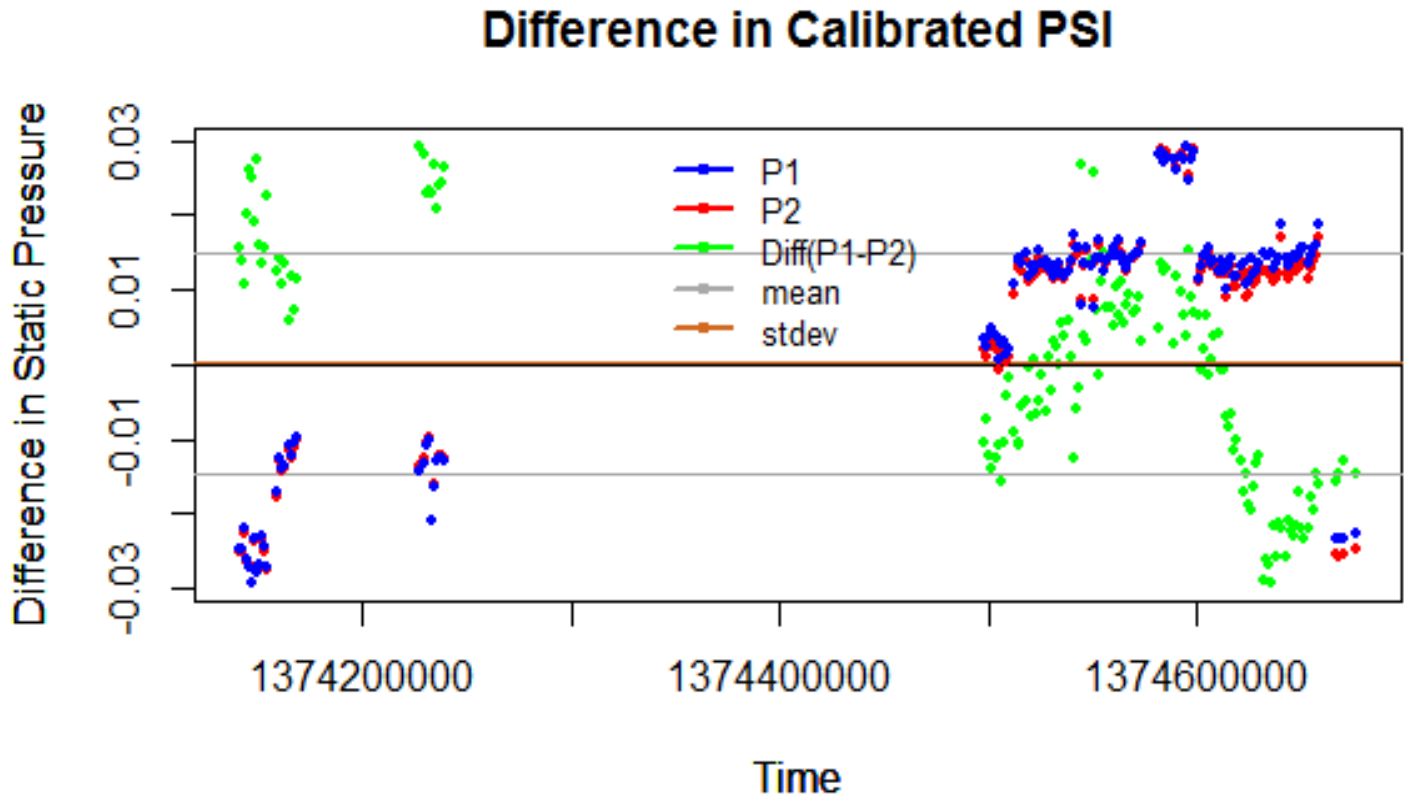
Code Calibration Process

- Find flow events
- Calibrate raw pressure to head height to compare P1 and P2



Validate Calibration Process

- Check calibrated static condition pressure data: Difference of P1 and P2 should be zero



Finding Flow Rate

- Use calibrated dynamic condition data to solve for flow
  - Given P1, P2, and diameters of pipe : **Bernoulli's Equation** yields flow rate

$$Q = A_1 \sqrt{\frac{2}{\rho} \cdot \frac{(p_1 - p_2)}{\left(\frac{A_1}{A_2}\right)^2 - 1}} = A_2 \sqrt{\frac{2}{\rho} \cdot \frac{(p_1 - p_2)}{1 - \left(\frac{A_2}{A_1}\right)^2}}$$

- Compare Flow/Head with manual tests
  - Unfortunate Data
    - Expected: .03 L/s
    - Our Data: 4.3 L/s
- Flow/Time= Volume of water

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