

Matt Steiman

Evolution of Irrigation at the Dickinson College Farm

■ Irrigation System?

- Irrigation is expensive, resource intensive, time consuming, and potentially frustrating!
- Do what you can to reduce or avoid the need to irrigate:
 - Mulch, Organic Matter, Cultivation

Rule of Thumb!

- Don't wait until your crops are dry to figure out how you'll water them.
- Plan ahead to develop a system that works when you need it
- Your irrigation person should be somebody who likes problem solving, is technically inclined, OK with walking back and forth, doesn't mind late hours
- Scale up as your farm and budget grows

Planning

Water Source?

- The amount of water you have available will determine how much and what type of irrigation you can achieve
- Well, Spring, Creek, Rainwater Catchment, City Water?



Storage



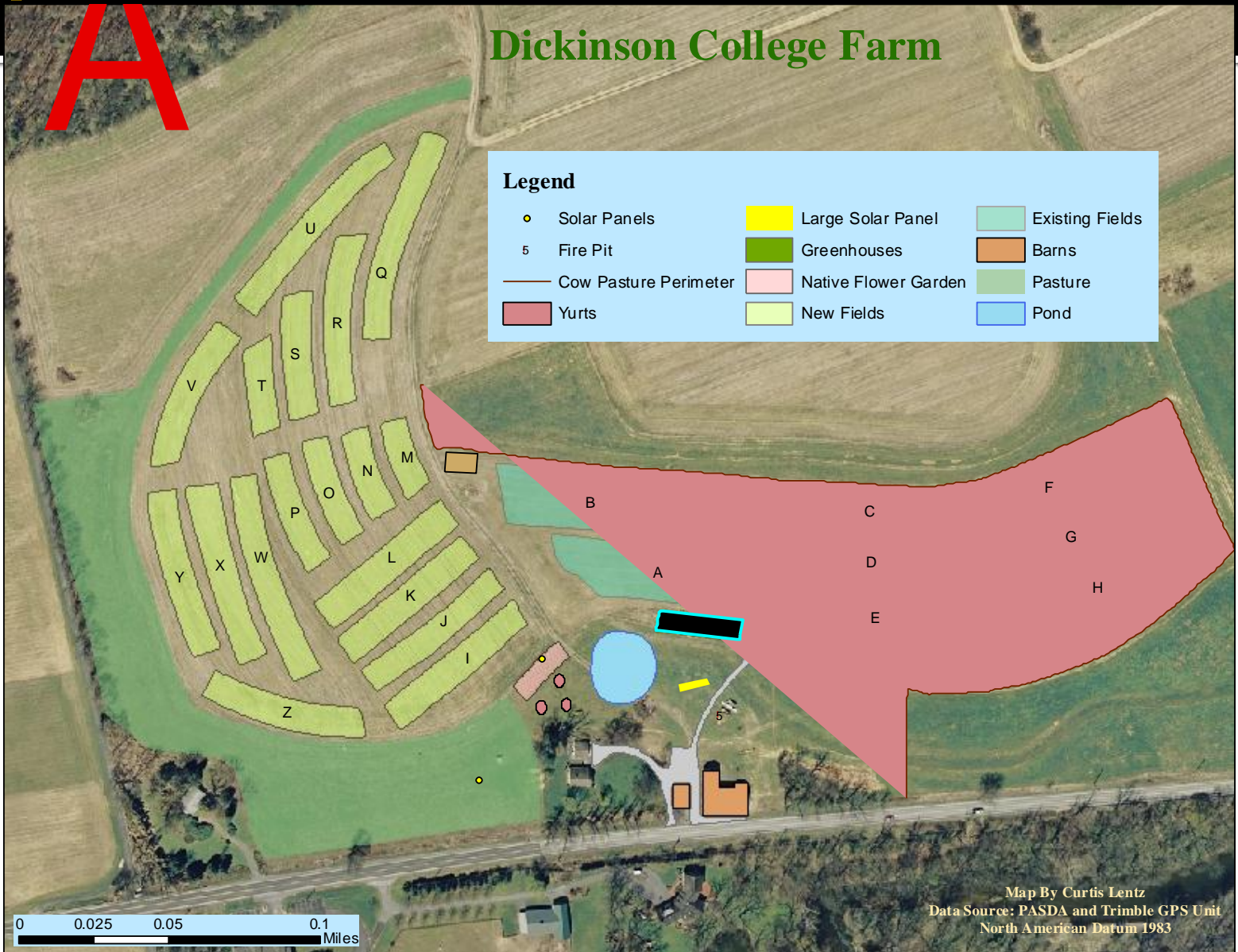
- Water storage is essential for dry times, unless your source is consistent (creek, etc.)
- We built our pond to accommodate more than the maximum anticipated water use over the development of the farm
- Approximately 500,000 gallons of storage
- Filled by well and rainwater catchment
- Pond cost:
 - \$7000 bulldozer work
 - Donated pond liner
 - Farm labor



Pond:

- Aesthetics, Wildlife Habitat, Fish, Swimming?
- Maintenance, Algae, Liability?

Layout



System options

- Direct pump from consistent source
- Pump from stored water
- Gravity feed
- Solar pumping
- Combinations?

Suppliers



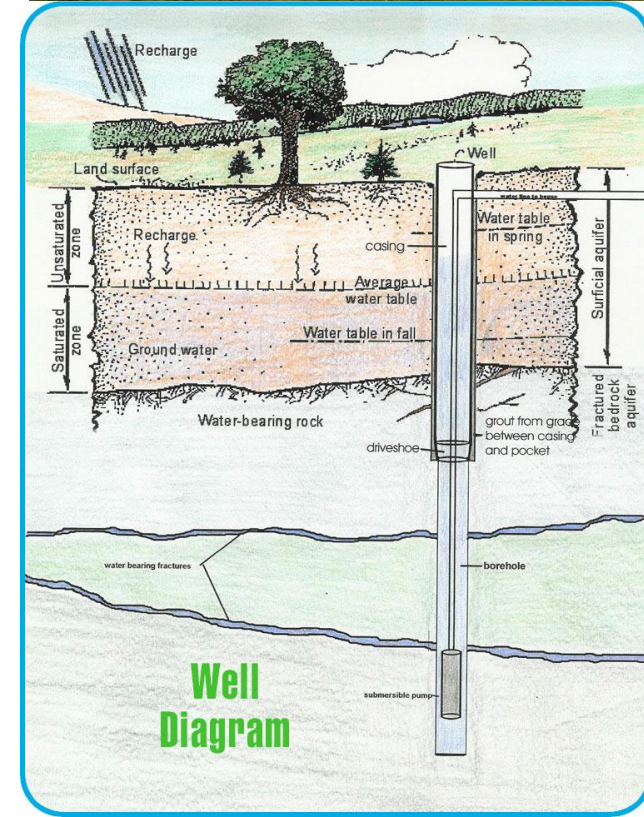
Rain flo: 717 445-3000 www.rainfloirrigation.com

Find somebody trustworthy who will help you out!

On campus support?

Water source: well

- About 20 gallons per minute, 24/7
- “Boiling Springs”
- Solar powered via grid tied solar array



Water source: rainwater swale



Water delivery: Gas Pumps

- Small engine gas pumps are effective, affordable and common
- Good way to get started for small investment
- Maintenance, fuel and oil consumption, mess, operational challenges, noise



Electric pump: 10 HP, 200 GPM



Electric pump benefits!

- Quiet, clean
- Push button start/ stop
- Remote start possibilities
- Can be connected to grid tied solar electric power
- Bigger pump can run multiple fields at one time

Variable Frequency Drive

VFD:

- Advanced electronic pump motor controller
- Allows adjustment of pump speed to deliver the water that you need
- Saves energy
- Automation options



Pump House



Pump system costs:

- Gas pumps: \$100 used & up
- Diesel pumps \$2,000 to \$4,000 and up
- Electric pump system:
 - Pump, VFD and associated components \$4,000
 - Pump house: \$6,000 custom built
- Well pump and well: Approx \$5000 plus wire from power source

Water delivery: Blue Vinylflow

- Vinyl-flow is the preferred brand
- We use mostly two-inch, three inch for some longer runs
- “The best \$100 I ever spent!”



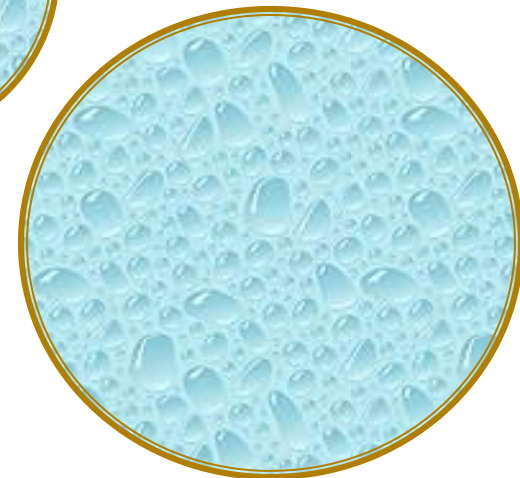
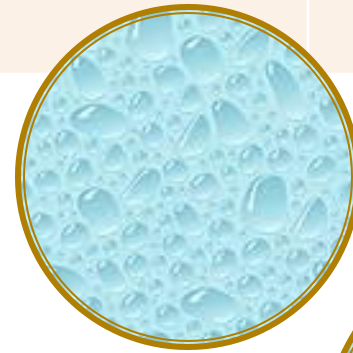


Friction Loss, PSI per 100 feet

Gallons per minute	2 inch	2.5 inch	3 inch
40	1.1		
60	2.4	1.4	1.0
80	4.1	1.9	
100	6.0	2.8	1.2
200	22.0	7.0	3.5
350		22.0	

100 GPM, 1500 feet:

- Lose $15 \times 6 = 90$ PSI with 2"
- Lose $15 \times 2.8 = 42$ PSI with 2.5"
- Lose $15 \times 1.2 = 18$ PSI with 3"



Fittings for Blue VinylFlow





Pros and Cons of Blue Tube

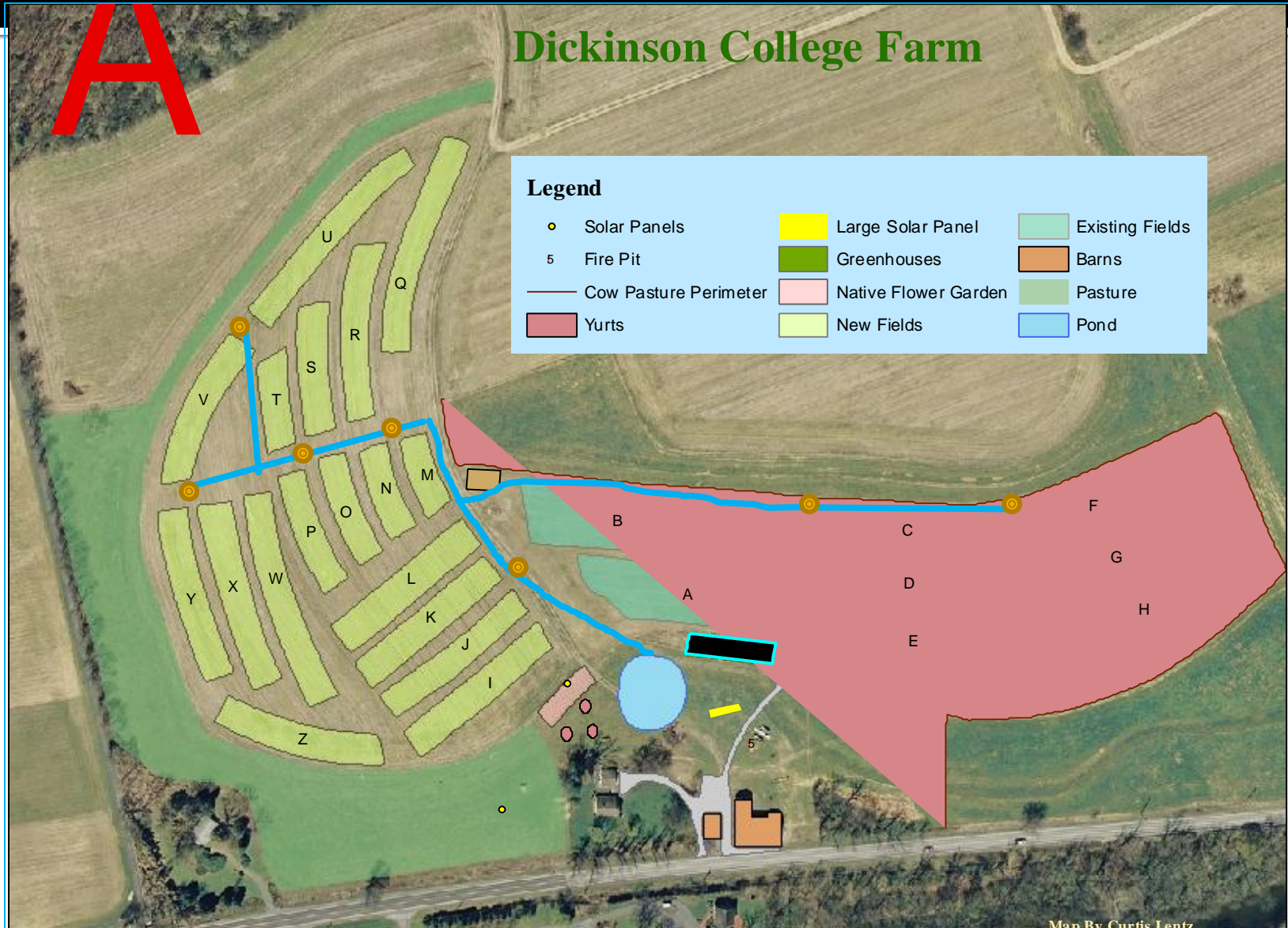
■ PRO:

- Affordable, versatile, easy to work with
- Temporary, reusable
- Long lasting (Vinylflow lasts several seasons)
- No commitments

■ CON:

- Gets in the way of vehicle & equipment traffic
- Leaks over time with abuse
- Gets lost in the grass, mower damage etc.

2011 Improvement: Buried Main





- Installed 2080 feet of 4" SDR 26 pipe
- Bell and Gasket for easy install
- 18-24 inches deep – (not frost proof)





Rocks at all
joints for thrust
blocks



Off-set valves in case of accidents



T posts and Pits





Water Usage: Drip Irrigation



■ Drip Benefits:

- Water efficient!
- Water only the crop row
- Reduce weed pressure by not watering paths, between rows
- Minimal evaporation
- Does not wet crop leaves

■ Drawbacks:

- Disposable
- Frustrating at times

**Drip is ideal for tomatoes, peppers,
squash, melons**



Drip connected to "Header"







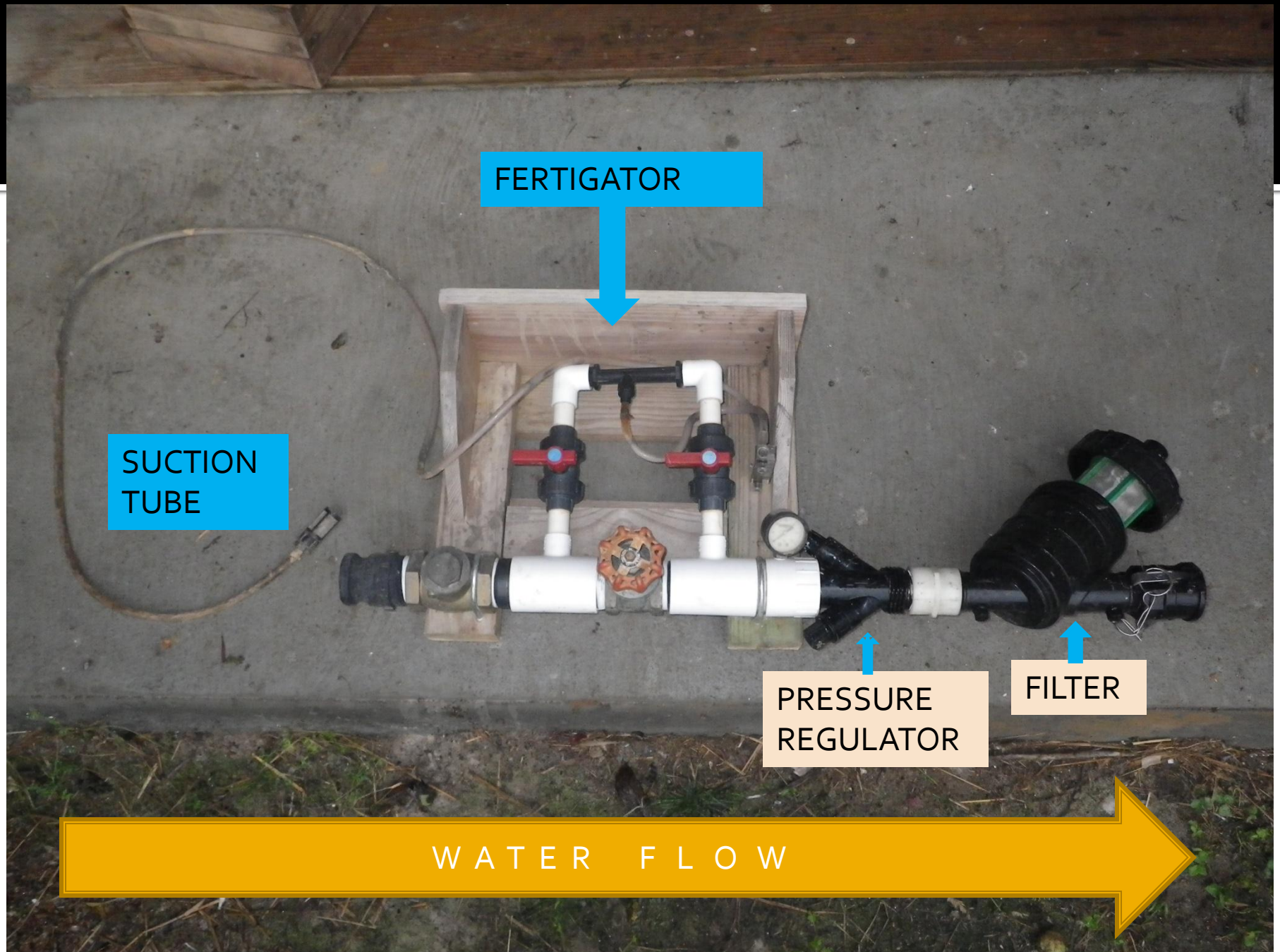
FERTIGATOR

SUCTION
TUBE

PRESSURE
REGULATOR

FILTER

WATER FLOW



"Fertigation"

- Inject water soluble nutrients into drip lines
- We use liquid fish based products (Fertrell 4-2-4)
- Increase yield and quality of tomatoes, peppers, squash, melons





Buried Drip

Burying drip
reduces
surface weed
pressure

Easier
weeding with
no tape on
surface



Single use plastic tubing





- Re-use of drip tape is very time consuming
- My conclusion after 10 years of trying, its not worth the headache and labor
- Used drip tape can be recycled
- Must be tied in neat bundles, no twine
- Google: "PA Plastics Recycling List"

WATER USAGE

- Medium flow drip uses $\frac{1}{2}$ gallon of water per 100 feet per minute
- Between 25 – 100 gallons per minute per acre
- Example:
 - 300 foot rows, 10 rows = 3000 feet
 - $30 \times \frac{1}{2}$ GPM = 15 gallons per minute plus leaks
 - 6 hour session = 5400 gallons +

Experience:

- Ideal “set” is about 6 hours, 2 – 3 times each week in hot dry weather
- Our well puts out about 20 gallons per minute
 - Able to run a few fields at a time directly from the well, or whole farm from the electric pump and stored water

Filtration

- Water must be filtered or it will plug tiny emitters and ruin drip tape
- Algae in ponds and above ground tanks will require frequent filter changes
- City water or well water typically not too bad



Sand Filters : 90 gallons per minute



OVERHEAD IRRIGATION

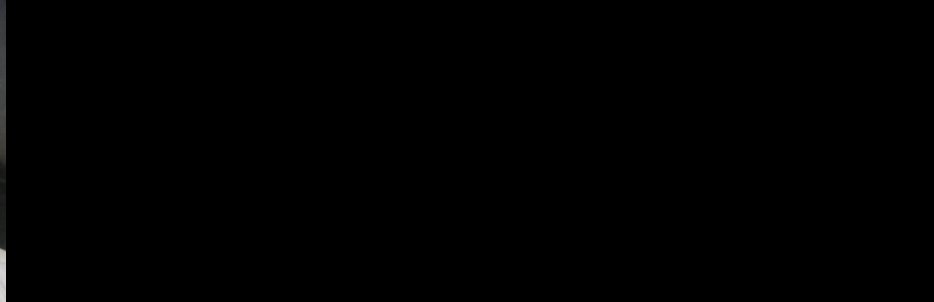


Overhead Sprinklers

- Pipe lasts for decades if cared for
- Great for watering in direct seed crops:
 - Lettuce, salad, spinach, carrots, beans, broccoli, etc.
- One pipe can be moved around the farm
- Water and energy intensive
- Risk of evaporation & low efficiency
- Labor intensive to move, run at night
- Increased weed pressure due to thorough wetting

4 Inch Rosebud style pipe





2 Inch hook and latch: preferred!



Buy at auction! Buy used!



Don't do this!



Impact sprinklers, aka "Birds"



PART-CIRCLE BIRDS



Part-circle adds control options



Typical scenario

- Set up pipe and check it
- Connect water source
- Remove plug and flush debris (mice, toads, rocks, soil)
- Plug pipe and pressurize
- Check for stuck birds, leaks
- Adjust pump pressure & run



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Experience

- In dry times, we try to run each field every three days more or less
- A “set” is about 1.5 hours
- Run in early morning or late evening, night to avoid wind and evaporation
- Pay special attention to new seedlings, plantings
- Don't get behind
- Keep track

NEW PUMP

[illegible]

Move pipe from field to field





WATER USAGE: OVERHEAD

- Typically 5 gallons per minute per bird, 50 PSI
- Example:
 - 300 foot field, 20 foot pipes
 - 15 pipes per field = 15 birds
 - $15 \times 5 = 75$ gallons per minute, plus leaks
- $75 \text{ GPM} \times 1.5 \text{ hours} = 6750 \text{ gallons} + \text{ per set}$
- Compare to drip at 5400 gallons per set, plus drip is more accurate with water placement at crop

Experience

- Spending money on irrigation brings rainy years
- Making your system efficient and easy will pay off in reduced labor & headaches and healthier crops
- Building a system that allows us to water multiple fields at once is a huge relief in the high season

Alternate storage options



Gravity feed: 1 PSI per 2.3 feet of head



•“HEAD” is vertical drop

•Subtract friction loss

•Drip needs about 10 PSI minimum (23 feet)

•Algae is a pain in above ground tanks

Greenhouse irrigation: \$200 and worth every penny!



RONDO mini sprinklers



Design a system to fit your house



Automation

- Affordable controllers for simple projects: \$150 for two valve system
- Useful if you can't be on site every day
- Battery operated
- Leaks can be a problem



Which system is more labor efficient?



Learn your parts, keep some stock



Thank You!
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