Improving your Irrigation System

Irrigation Ditch & On-Farm Improvement Options

Jackson Soil and Water Conservation District
Paul DeMaggio, P.E., CIS, CAIS
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Welcome

* Jackson Soil and Water Conservation District
  * Who we are and how we can help
* Irrigation Ditch Improvement and Modernization Overview
  * Goals, Issues, solutions, examples
* Quantifying benefits of ditch improvements – Grant requirements and how to get funding
* On-farm irrigation system overview and improvement options
* Questions and Discussion

Jackson Soil and Water Conservation District

* Locally funded by Jackson County property taxes since 2006 to help landowners improve the management of their land and their shared resources while enhancing the natural environment.
  * Technical support, designs, planning, mapping
  * On the ground site visits
  * Scientific studies and effectiveness monitoring
  * Seeking/providing funding assistance for projects
  * Educational workshops and classes
  * No cost for services, non-regulatory
  * www.JSWCD.org

Irrigation Ditch Improvement Goals

* Efficient use of water for beneficial purpose without waste
  * Only the amount needed for the intended purpose
  * Less seepage, leaks, spills, less irrigation runoff, less water use by weeds along the ditch
  * More control and measurements
* Improve Water Quality of nearby creeks, rivers, groundwater
  * Less erosion and sediment, colder water temperatures, less bacteria and nutrients, higher flow rates, more habitat access

Irrigation Ditch Improvement Goals

* Increase agricultural productivity
  * Local food/fiber economy
  * Reduce labor requirements for ditch maintenance. Labor is a major factor.
  * Improve water supply, stability and flexibility.
  * Cleaner irrigation water with less weed seeds, bacteria, etc.
* Share the water resource with aquatic habitats and wildlife
  * More efficient water use = less water diverted to meet crop water demands

Irrigation Ditch Benefits – Adjacent Landowners

* 'Free' water – no pumps
* Easy to see the water and see the leaks
* Artificial habitat for birds, insects, amphibians, ect.
* Groundwater
* Livestock access and wildlife access to drinking water
* Stormwater conveyance/drainage
* Aesthetics, water feature, walking trail

Irrigation Ditch Issues – Typical

* Aging infrastructure over 100 years old. Many were historically mining ditches
* Over time: Few, large irrigated areas → Many, smaller irrigated areas. More irrigators to manage on ditch. Less irrigated acreage, fewer professional farmers, less irrigation knowledge.
* Large trees along ditch use significant water and can destabilize banks.
* Ditches easily choked by vegetation if not maintained
* Unlined, earth ditches with seepage losses.
* Rodent damage on earth ditches can be catastrophic
* Ditches may be on steep hillsides with difficult access.
* Conveyance efficiency of ditch may be 50%. (e.g. Divert 4 CFS, only 2 CFS arrives at end of ditch)
* Last properties on ditch may not get their allotted water. Unequal water distribution to all water users on ditch.

Irrigation Ditch Issues – Typical

* Irrigation districts and associations may have minimal funds for infrastructure improvements. Or unwillingness to use funds for improvements. Water projects and irrigation projects may not be a priority. Infrastructure is good enough.
* Water is diverted whether or not crops need it. Difficult to make minor adjustments at the diversion. Excess water that isn't used by crop either flows out the end of the ditch, or over the land, or into groundwater
* Difficult to manage water when not measured. No meters on individual turnouts, only metered at diversion. No volume measurement.
* Low incentive to use less water. Cost of water is minimal or free (except for labor). Fees are not based on water volume, only based on water righted acres.
* Constant coordination with neighbors. Neighborhood cooperation is paramount to a well maintained and operational ditch. One bad actor can cause large disturbance.

Irrigation Ditch Issues – Typical

* Access to diversion, to sections of ditch, may be blocked by neighbors who don't think there is an easement. May not be a formal easement filed for these properties. Handshake agreements common.
* Ditch crosses multiple properties and roads, public and private.
* Local governance of ditch may be loose or non-existent. Complex legal tools and challenging enforcement.
* Ditches (and associated seepage and flood irrigation) have created artificial wetlands, artificially high water tables, larger water loving trees, aesthetic water features, artificial wildlife habitat, etc. Can become regulated.
* Stormwater and upland irrigation may be captured in the existing open ditch. Ditch may double as stormwater conveyance or roadside ditch causing sediment issues and blowouts.
* Easy for others to steel water.

Ditch improvement options

* Lined ditch, piped ditch, pressurized system, pumping?
  * Irrigator preference or past experience
  * Material cost, installation cost
  * Lifespan and maintenance
  * Contractor experience and preference
  * DIY vs professional installation
  * Buried Pipe is considered the most efficient, least maintenance, longest lifespan.
* Try piping the entire ditch from the beginning to end, with a pressurize rated pipe. If not feasible, then fix only the leakiest sections
* Compare ditch improvement options with pumping options

Ditch Lining Alternatives

* HDPE Rigid Liners

* Flexible Liners – Plastic, Rubber

* Concrete or Shotcrete

* Clay or Bentonite

Piping Alternatives

* HDPE – Solid Wall
  * Fusion welded
* HDPE – Corrugated
  * Single Wall
  * Double Wall – Smooth inside
* CMP
  * Corrugated Metal Culvert Pipe
* PVC
  * Gasket
  * Solvent Weld
* Concrete Tile

Best to get a site-specific recommendation from an experienced professional.

Proper Installation is extremely important for all liners and pipelines.

Grants

* JSWCD Grant for this type of project
  * Up to $50,000. 1:1 match
  * Begin with site visit with Meghan and Paul
  * Fill out general intake planning form with contact information.
  * 1 to 2 year time between initial contact and grant acceptance. Planning, data collection, designs, meetings, etc.
* OWEB, OWRD, USBR or other

How to be successful with a major ditch improvement – with grants

* Must Identify quantifiable public benefits. Social, economical and environmental. Typically, a year or more of planning and data collection.
  * Find out where and how much water is being lost
    * JSWCD and OWRD can measure, coordination with irrigators
  * What is the water quality of the irrigation return flow going back into the river
    * JSWCD can measure, coordination with irrigators
  * Labor hours required now vs labor hours required once fixed. Economic and social benefits.
    * Irrigators and landowners
  * How will the improved water delivery help with farm production.
    * Irrigators and landowners

How to be successful with a major ditch improvement – with grants

* Point person for the ditch who is willing to pull together other landowners in support of the project
  * Maybe someone near the end of the ditch
* Local agency support, SWCD's, Watershed councils, Trout Unlimited (TU), Freshwater Trust (TFT), Greater Applegate, who can find more partners and funding, aid in grant writing, monitoring, etc.
* Water rights must be reviewed, easements and existing agreements must be reviewed. Prescriptive easement already along the ditch.
* Many iterations and meetings may be needed to identify a project that all water users agree on. Flexible design considerations.
* Phase the project to reduce the grant fund ask.
* Used experienced contractor and designer with agricultural pipelines. Get input at the beginning of the project and planning if possible.

Common Questions

* Will my water right decrease if grants are used?
  * Yes, the flow rate and volume may decrease on the water right document.
  * Flow rate at diversion may be decreased.
  * Irrigated acreage stays the same which means property value stays about the same.
  * Water available for irrigation on-farm will stay the same or increase, after the ditch improvement project. Because of improved conveyance efficiency

Common Questions - Continued

* Current System Example:
  * 4 CFS is diverted now into ditch. Existing water right.
  * 2 CFS is lost before it makes it to the middle of the ditch.
  * 2 CFS is available (on average to irrigators). irrigators on the last half of the ditch are under-irrigating in mid summer.

* New Efficient System:
  * 3 CFS is diverted into ditch/pipe. Water right is reduced.
  * 0.01 CFS is lost in new pipeline.
  * ~3 CFS is available to all irrigators. Irrigators on last half of ditch have 50% more water.

* Many other examples of this trade and win-win for irrigators and environment in Oregon.

Common Questions

* How much will it cost me?
  * Depends on amount of public benefit, environmental benefit, social and economical benefits.
    * How much water is available to trade for funds?
    * Is there a measurement water quality benefit?
    * This will determine how many grants are willing to fund the project
  * Depends on who is doing the installation
    * Can the installation be done by landowners. Instead of paying cash, pay with labor and equipment use.
  * Risk and scope of project.
    * Does the design and installation need a professional engineer, geotechnical investigation, new elevation surveys?
      * Larger projects that have risk of litigation if something goes wrong.
  * How large of a loan can be procured? How much debt are landowners or the association willing to have?

Common Questions

* Will my irrigation water delivery be the same?
  * Yes, or better and easier to manage

* Will irrigation district or association dues go up?
  * No, they shouldn't go up as a result of the project or any larger water conservation project.
  * However, dues should be increased by a % each year to cover inflation and increased material costs.
    * % increase per year can range from about 1% to 8%.
    * Fees are determined based on costs to maintain the ditch.
    * Annual fees can range from $70 per acre to $500 per acre for irrigation districts with many patrons.

Next Steps

* Schedule a 'ditch walk and site visit' with JSWCD, APWC, OWRD and landowners to see the bad sections.
* Data collection during irrigation season. Flow measurements, water quality samples, water right research.
  * Generally take samples and measurements around July – August
    * JSWCD and OWRD can assist with these measurements.

Next Steps for Ditch Improvements

* Identify agency contacts, agency involvement (mainly JSWCD and APWC).

* Who is point person for the specific ditch?

Questions on Ditch Improvements?

* Short Break before next section about On-Farm irrigation overview and improvement options

On-Farm Irrigation Overview and Improvement Options

* Overview of Irrigation system types
  * Pros/cons of each
  * Things to consider
* Improvement Options
  * Where to begin
  * Can you get grant funds or cost share to help?

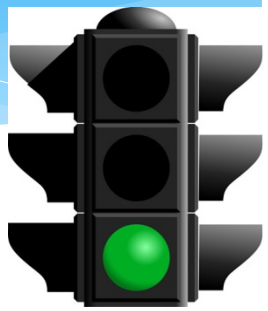
IRRIGATION SYSTEMS

* Types of system is decided by many things:
  * Crop type and Crop needs
  * Field characteristics (soil, slope, shape)
  * Water availability
  * User preference, Contractor preference
  * Material availability and local distributors
  * Labor Availability, lifestyle
  * Cost of Water and electricity
  * Animals
  * Other

FIELD CHARACTERISTICS

Rectangular fields
Flat slope
Loamy soils

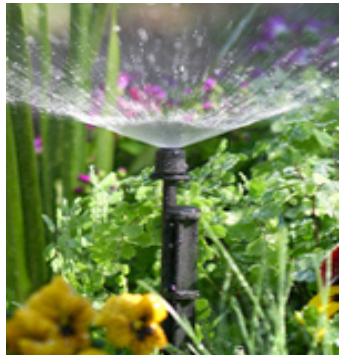
Many options – GO for it



Irregular Shaped Fields
Steep slopes
clay or sand soils

Fewer options - Pause

Options for Rectangular, Loam, Flat



Options for Irregular, Clay, Steep

IRRIGATION TYPES

* Surface/Flood Irrigation
* Sprinkler Irrigation
* Drip/Micro Irrigation

Flood Irrigation

Flood Irrigation Delivery

* 1:1:1:1
  * 1 cfs (typical flow rate onto your field from Irrigation Ditch)
  * 1 Hour (time the gate is open)
  * Delivers 1” of water over 1 Acre Field
* Typically delivery is 3”
  * 1 acre field would be irrigated for 3 hrs.
  * 10 Acre field would be irrigated for 30 hrs.

Flood Irrigation Volume

* Irrigation District Delivered Amount Typically:
  * **~2-3" of Water per Acre, every 2 Weeks.**
  * 80,000 to 100,000 Gallons of Water, per acre, per delivery
    * Per Acre every 2 weeks
    * 40,000 to 50,000 gallons per Acre per Week
    * **0.9 to 1.15 Gallons per Sq ft per Week**

Gated Pipe

* Aluminum or PVC
* Poly Tube
  * Flexible Gated Pipe

Gated Pipe

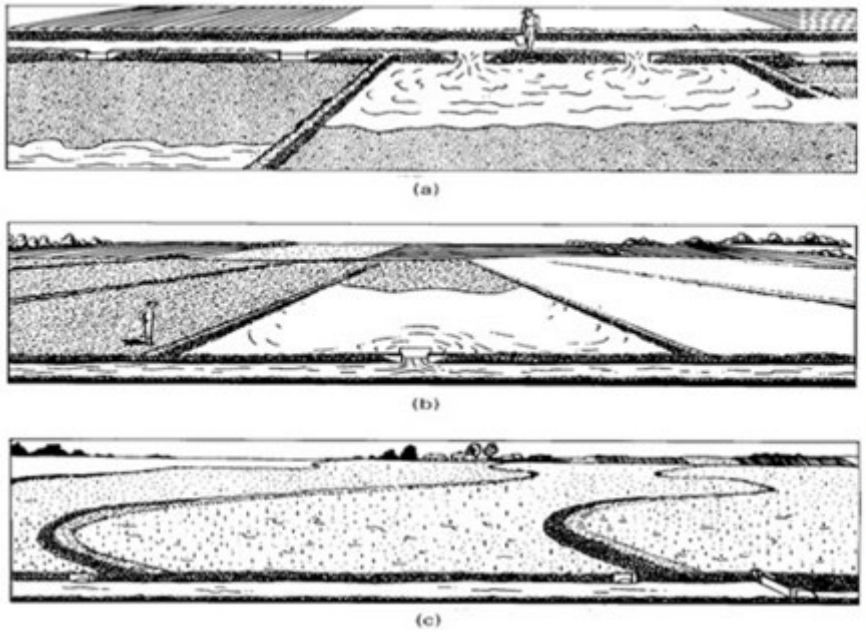
Gated Pipe

Flood Irrigation

Wild Flood

FLOOD IRRIGATION LAYOUT

Border Strip



Border Strip Flood Irrigation

Alternative Methods

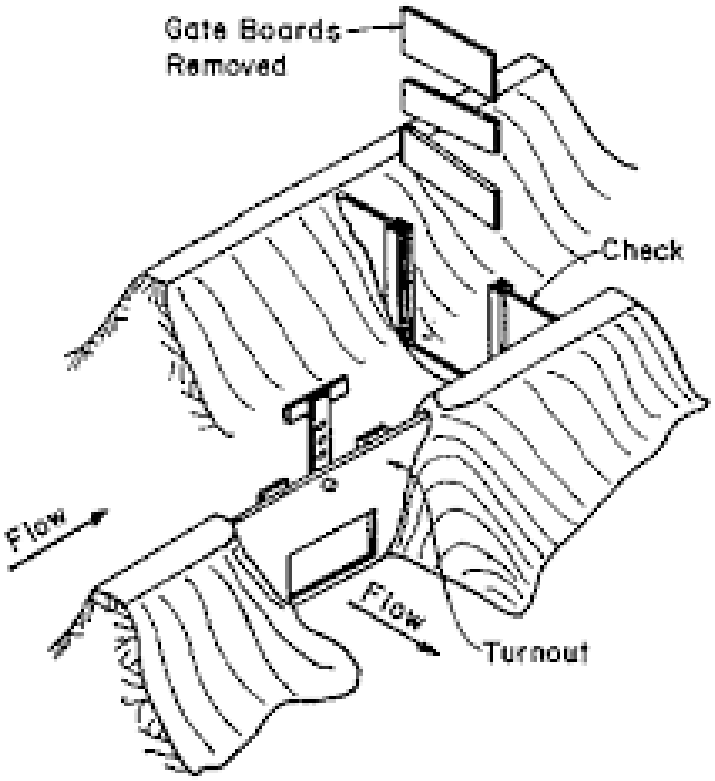
* Subsurface plowing (Keyline)
* Micro spreader ditches on Contour (corrugations)
* Berms, Ponds and Swales

Flood Irrigation Slopes

* Open Ditch Slopes
  * ~1’ Elevation Drop per 1000’ length (Larger Canals)
  * ~2-3’ drop per 1000’ length (Smaller ditches, contour ditches or private ditches)
  * ¼” per 10 ft good ROT for re-establishing contour ditches

Flood Irrigation

* Getting water out of the Canal
* Place ‘check’ every 100-300 ft



Flood Irrigation Distribution Box. Moving water to different irrigation ditches

Good Flood Irrigation on hay field. Notice the spreader ditches on contour

Poor Flood Irrigation on Pasture. Livestock and Inadequate maintenance time may have contributed to dry spots and poor irrigation distribution

Effective way to get water out of spreader ditch – pipe section blocked by tarp or board

Spreading water through field using a board and a notch in the ditch bank

Flood Irrigation Pressure Requirements

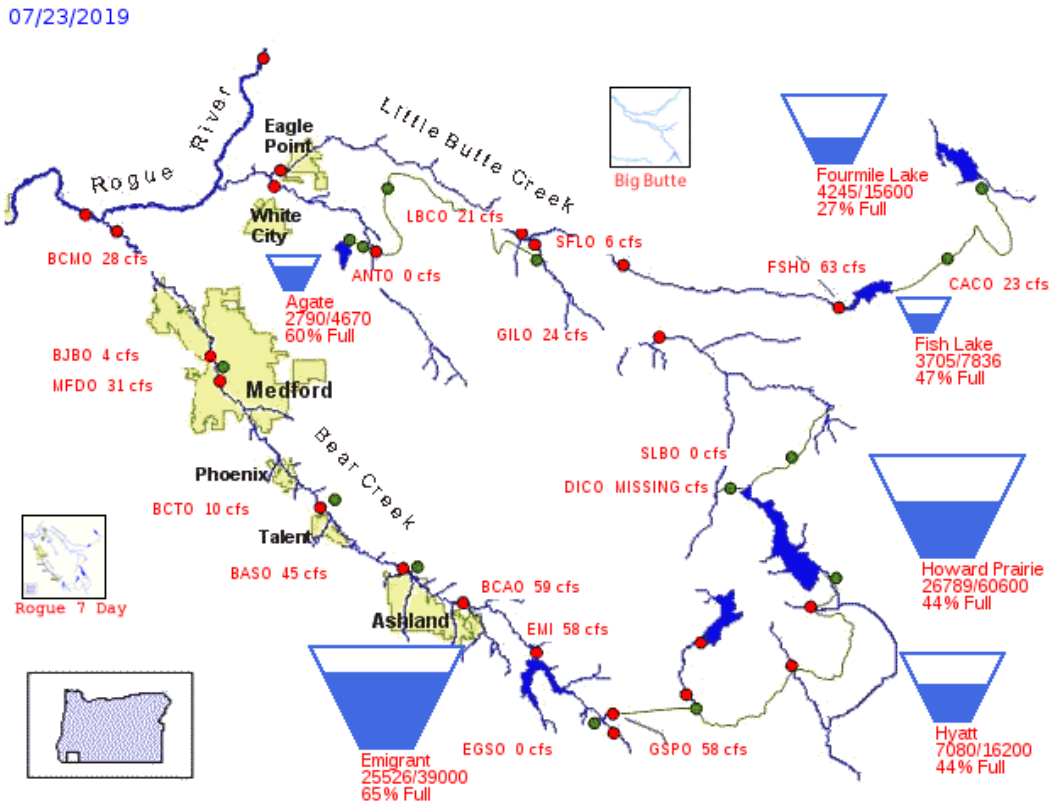
* Lowest Pressure of all irrigation systems
  * Gated Pipe is only type that requires a certain pressure (if coming from a ditch)
    * < 5psi or gates may pop off. 1-3 psi is typical.
* Some Irrigators pump water to an upper ditch from a river for flood irrigation.
  * In this case, pressure is a function of how high the lift is.

Flood Irrigation Filtration

* Fish Screens required where water flows from river into the ditch. O.D.F.W.
* Trash Rack is protection from larger debris. Cleaned manually

5 MINUTE STAND UP BREAK

US Bureau of Reclamation, Pacific Northwest Region
Bear Creek and Little Butte Creek Basins



PROVISIONAL DATA - SUBJECT TO CHANGE!

'Pressurized' Irrigation Types

* Irrigate where you want, when you want, for how ever long you want.
  * Location, Frequency and Duration
  * Maximize Crop Yields

* Pressurized options:
  * High labor/low cost OR Low labor/High Cost

Pressurized Irrigation

* Filtration usually required to prevent clogging
* Pressurized by Gravity, or by a Pump.
  * Opportunity for gravity pressure systems in this valley
* Pipelines installed above or below ground
  * PVC is pipeline of choice for buried pipe
  * 125psi or greater pipe pressure class

Hand line

PVC or Aluminum

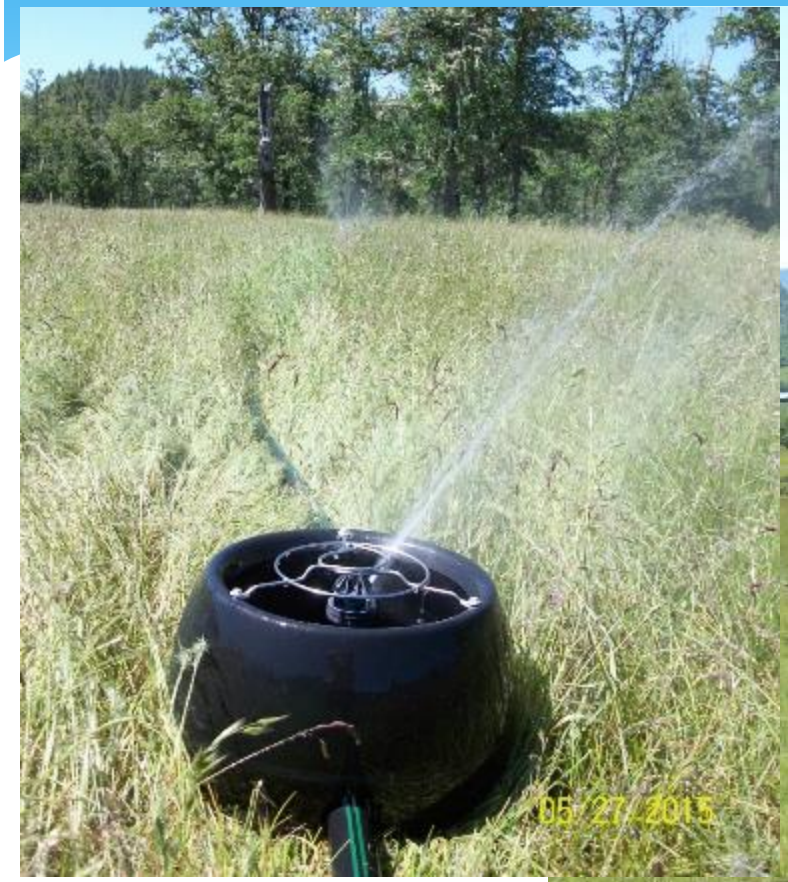
Handline Riser Valve

Hand Lines

Hand Lines

* Row Crops Typical
* Cheap option if cheap labor is available
* Flexible system for varying field shapes, sizes, and soil types
* Buried PVC pipe with risers to Aluminum Valve
* 2”, 3”, 4” Typical Size of Handline
* Animals can ruin aluminum lines
* 35 to 60 psi required at sprinkler
* Manually moving lines is tough
* Leaks

Pod Irrigation

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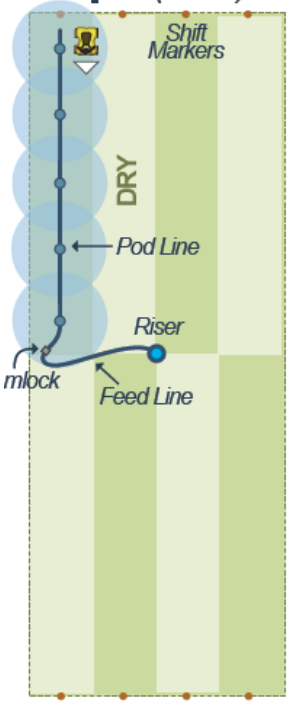
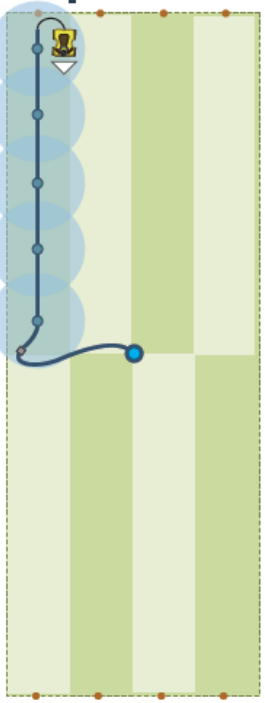
Pod Irrigation

Step 1 *(Set 1)*



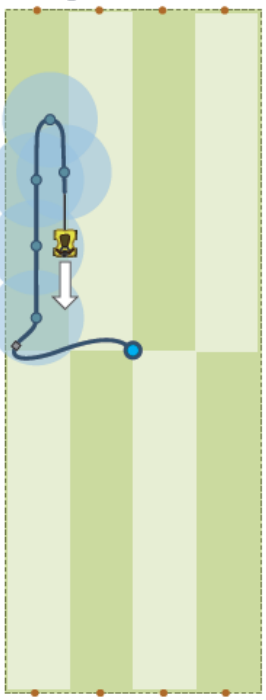
Facing the far end of the field, position your vehicle along side and 6 - 8' away from the sprinkler/pod line.

Step 2



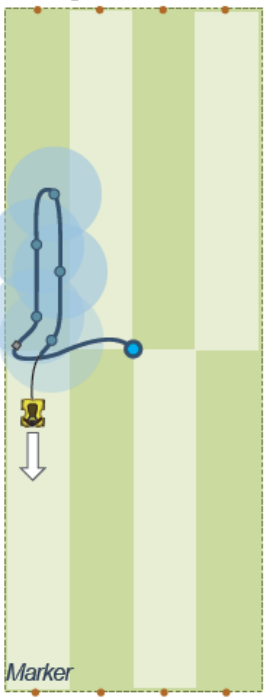
Attach the hook and rope at the end of the sprinkler/pod line to the tow vehicle.

Step 3



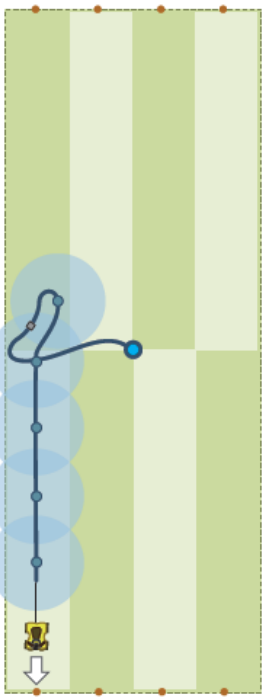
Drive along (parallel to) your sprinkler/pod line, staying within 6 - 8' of the line.

Step 4



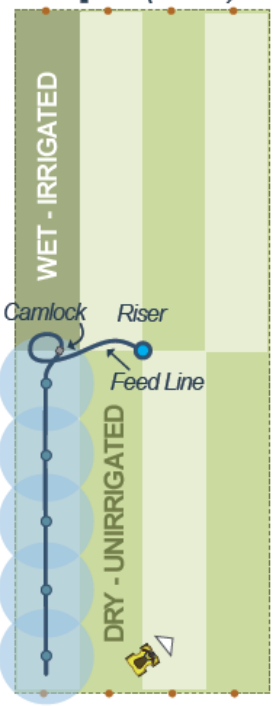
As you approach the midpoint of your field (running over the feed line), line up with your marker at the end of the field.

Step 5



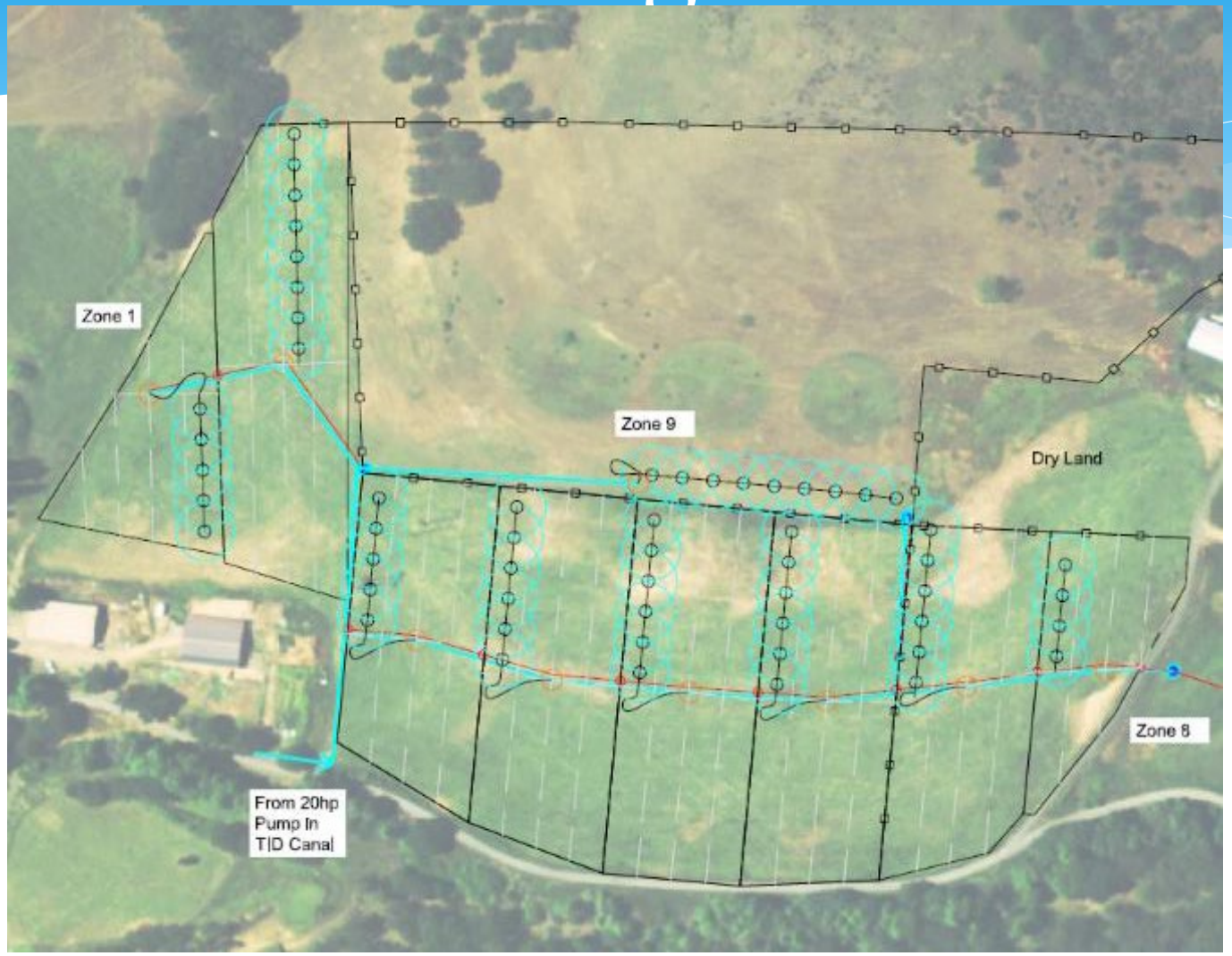
Continue to the end of the field and stop when the first pod is approximately 30' from the end of the field.

Step 6 *(Set 2)*



Unhook the sprinkler/pod line from your tow vehicle.

Pod Irrigation



Pod Irrigation Aerial

Pod Irrigation

* Less Labor than handlines
  * Move with a quad.
* Relatively Inexpensive/Acre
* Open Pasture for beef cattle or milk cows
* Buried PVC mainline with valve box connected to pod line
* Animal Proof
* 35 to 60 psi Required at sprinkler
* Easier to move than handlines
* Doesn’t leak

Wheel Line / Side Roll

Figure 5. A ¾ inch brass impact, and newer ¾ inch rotating style sprinkler; both designed for agricultural use.

Wheel Line Movers

Wheel Line Connection

Wheel Line Operation

SKIP: Irrigate every other riser down, then irrigate using the missed risers on the way back (Figure 4).

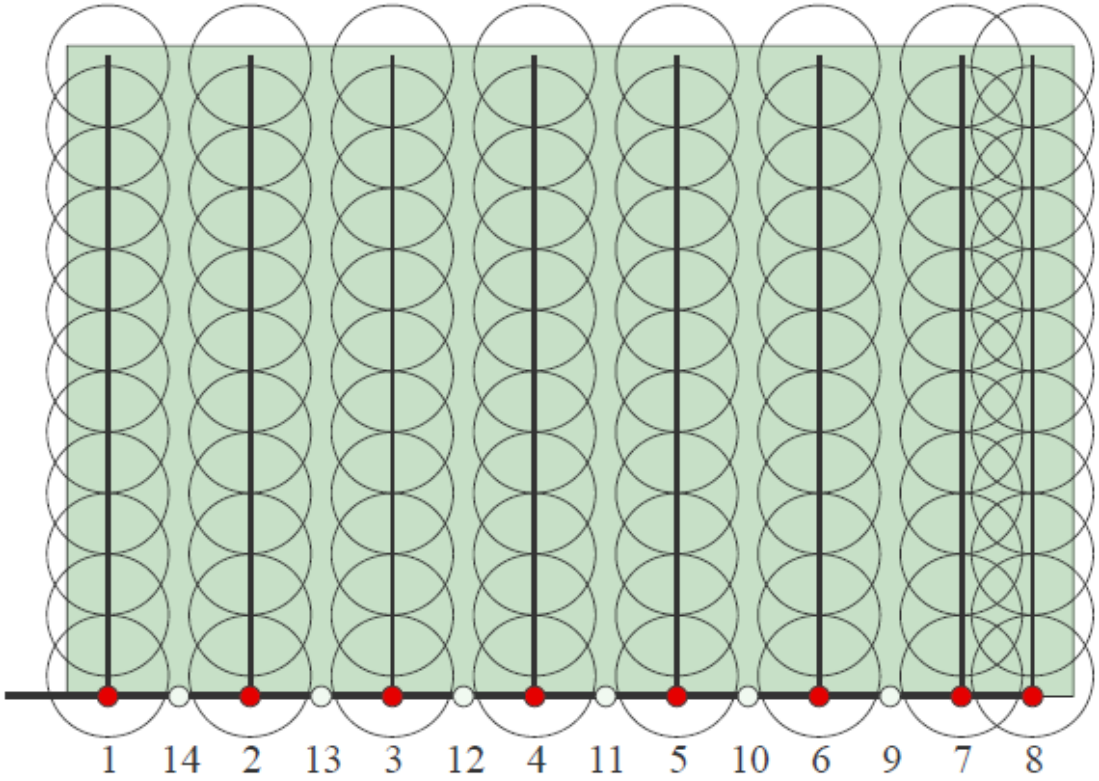
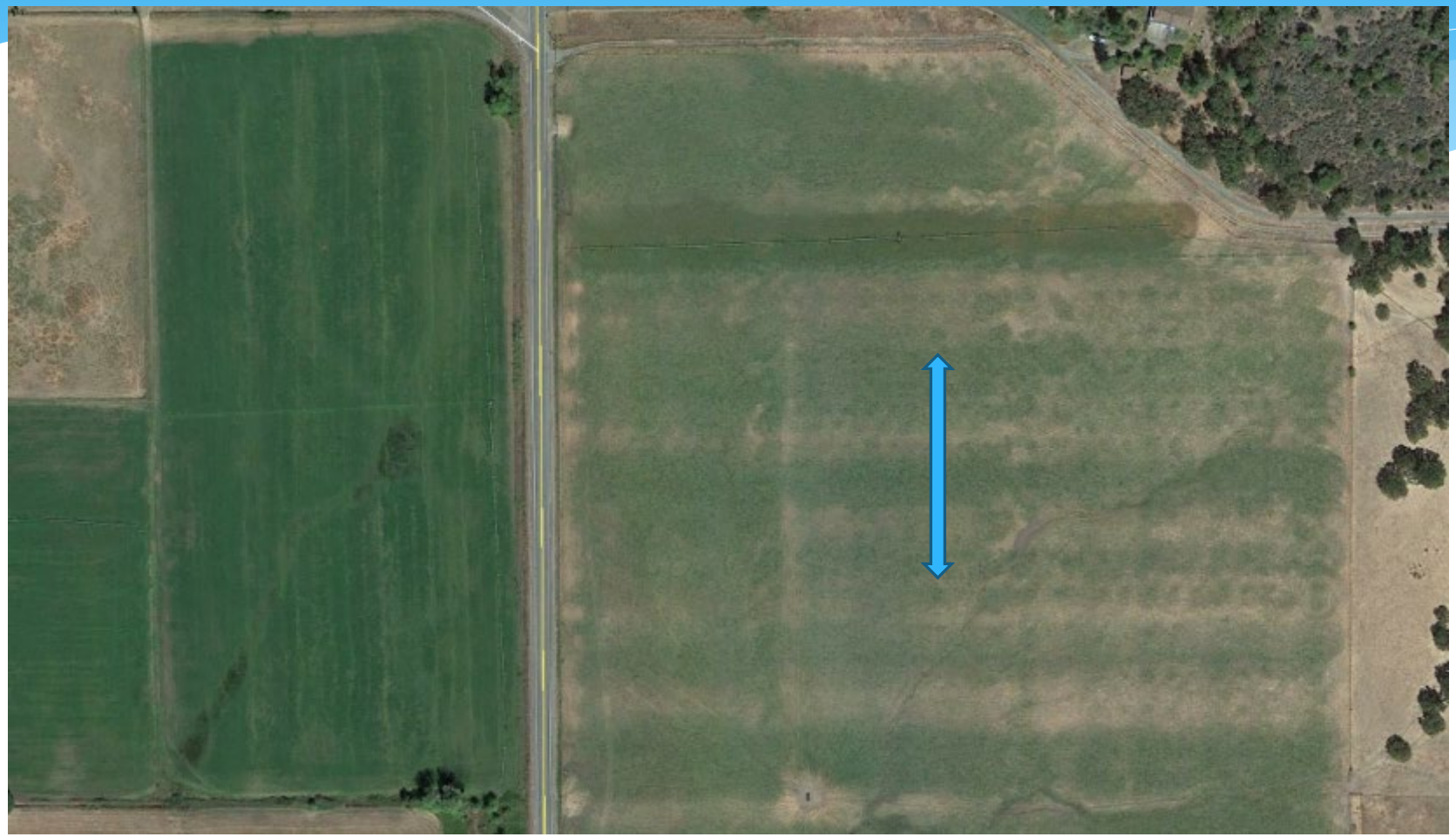


Figure 4. Showing the SKIP move pattern. Irrigate every-other riser down one side of the field (red), then catching the missed riser (white) on the way back (Riser 1 – 14 in order).

REF: Managing Wheel-Lines and Hand-Lines for High Profitability
R. Troy Peters, PE, PhD

Wheel Lines



Wheel Lines

* Great for Hay, also used for Row crops and Pasture
* Rectangular, generally flat fields
* 35-60+ psi at Sprinkler
* Same Pipeline layout as handlines
* Must drain entire line to move
* Proven technology, well used.

Big Gun Sprinklers

* Traveling Big Gun (Water Reel)
* Stationary Big gun on a cart
* Solid Set Big Guns

Big Guns (Water Reel)

Big Guns (Water Reel)

Big Gun Cart

Solid Set Big Guns

Big Guns

Big Guns

* Pasture, Hay, Sports Fields, Large Lawns
* Solid Set Big gun is most expensive system
  * Full Automation available
* Big Gun risers are not animal proof
* High Flow Rates per sprinkler, high application rates
* 50 to 100+ Psi required
* Can cause water runoff on soils with low infiltration rate
* May Require a quad to move around

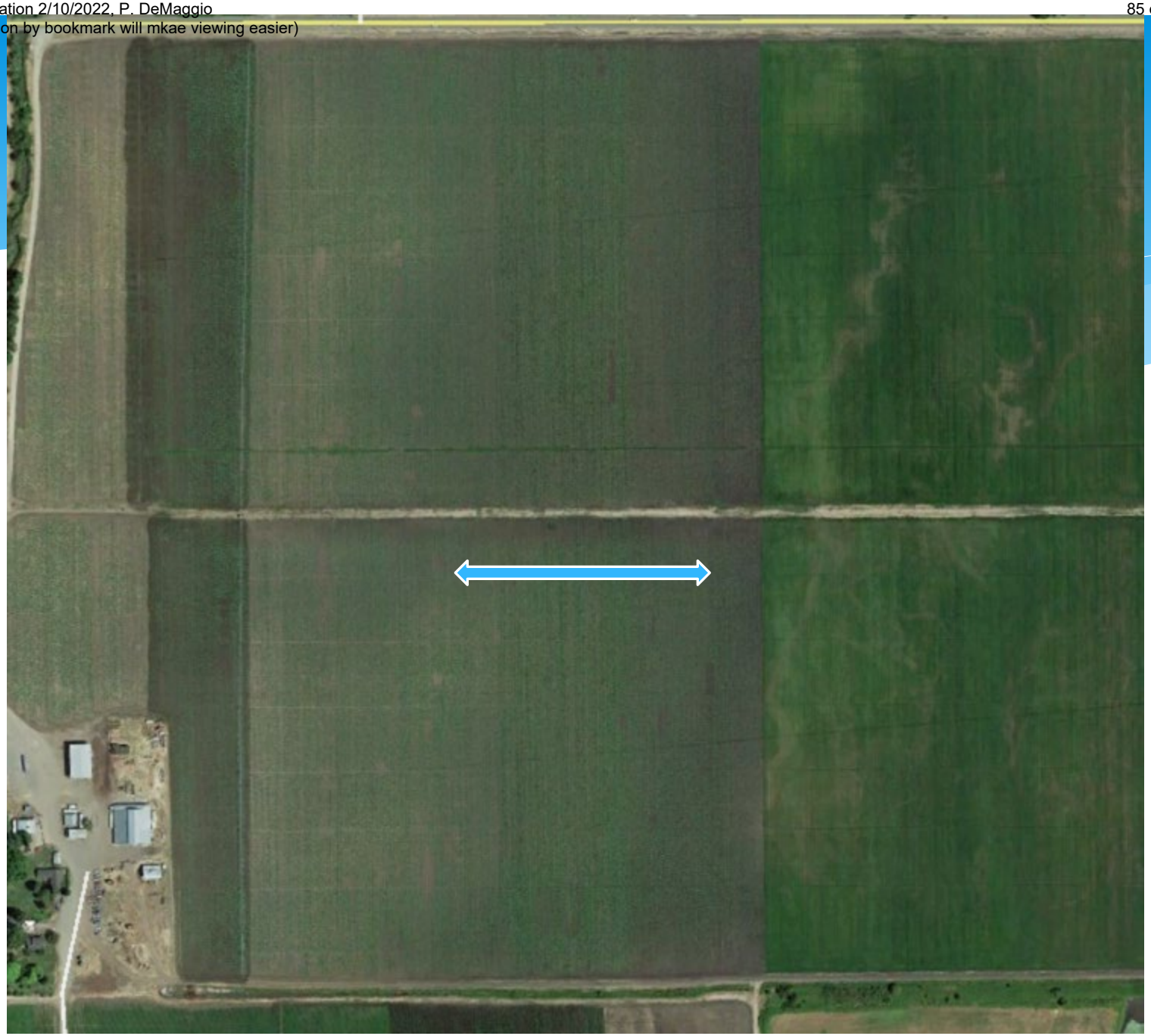
MicroSprayers

Micro-Sprayers

* High Efficiency
* Typically used for orchards
  * Also Called 'Undertree sprinklers'
  * Creates full wetted area for tree roots to grow between trees
* 25 – 50+ psi
* High installation cost (solid set)
* Automation available

Linear Move

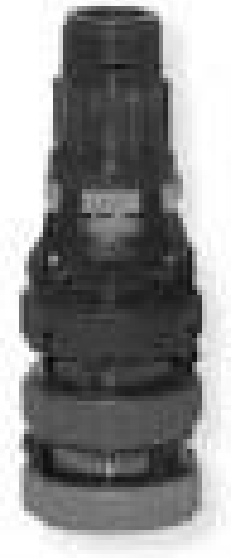
Linears



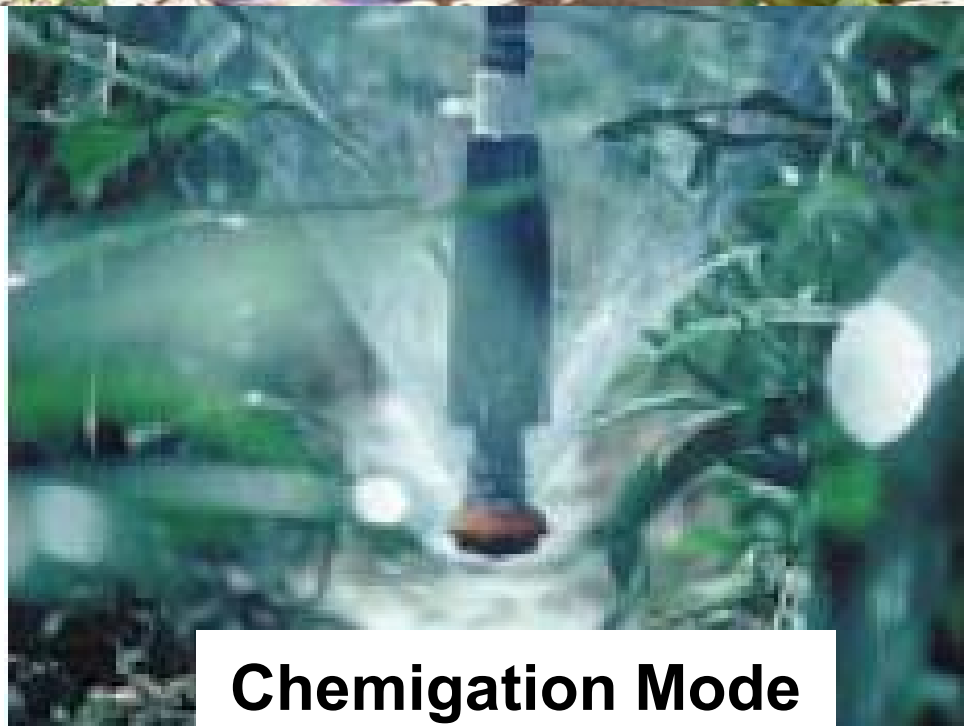
Center Pivot

Center Pivot

Sprays



Low Pressure



Center Pivot and Linear Move

* High Capital Cost – Low Labor Cost
* Automated
* Row Crops, Hay, Pasture
* Efficient up to 90%
* 30 to 60 psi at intake ~20 psi at sprinkler
* Electricity required
* Can be an Investment in Property Value

Sprinkler Filtration Requirements

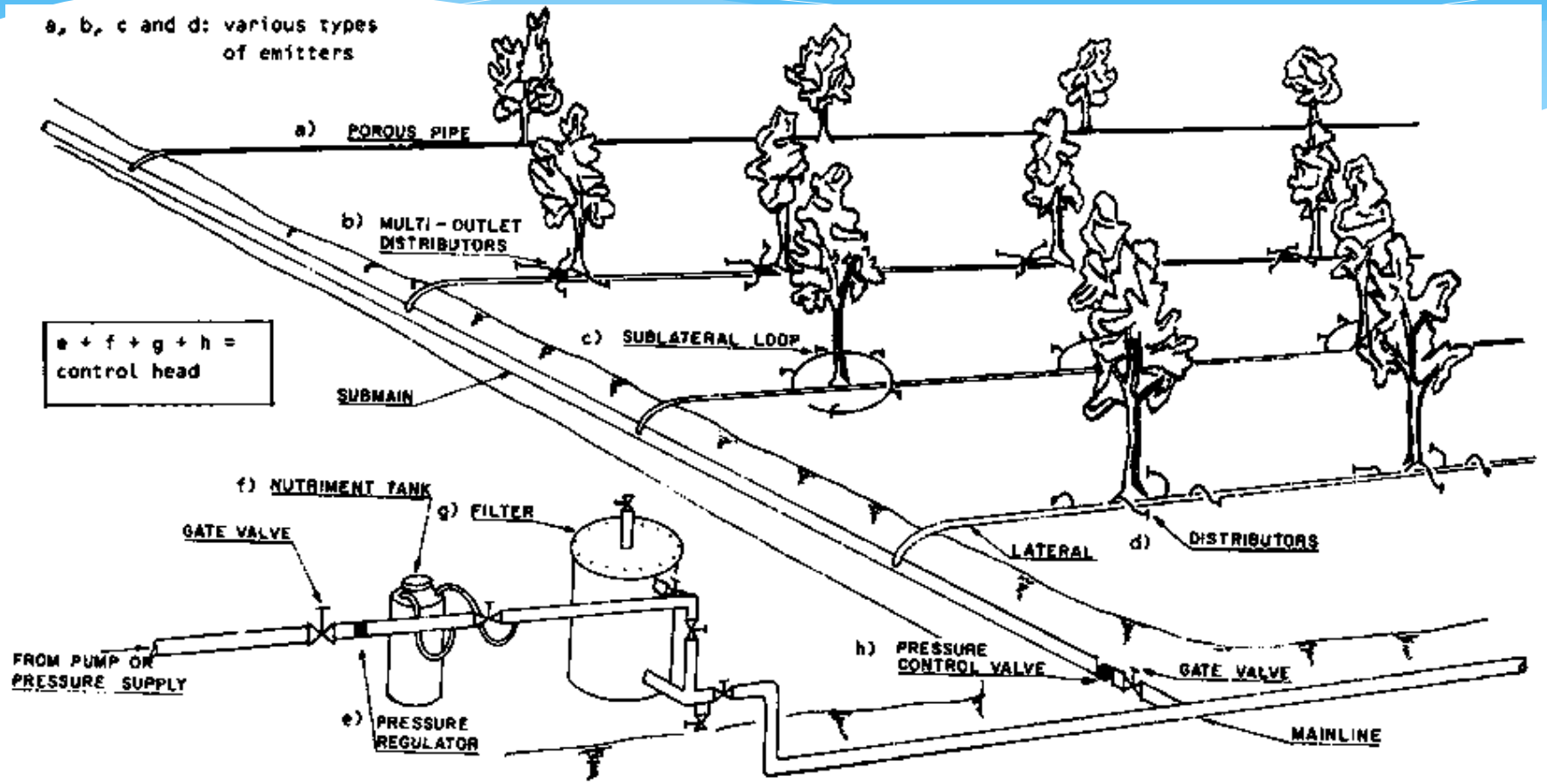
* Filter should be 2 to 5 times smaller than sprinkler nozzle diameter.
  * ~Above 16 Mesh (16 holes per inch)
  * ~Below 1000 Micron (size of opening)
  * ~Below 0.05 Inch (size of opening)
* Filter capacity should be at least 2 times the flow rate of system
* Use a 150 micron/100 mesh for sprinkler and/or drip to prevent wear on valves
* http://www.nelsonirrigation.com/media/resources/1.3_ROTATOR_FILTRATION.pdf

Sprinkler Filters

Water Volume

* Volume is determined by Crop water use and sprinkler efficiency.
* Good Rule of Thumb For Hottest Weeks=
  * **1.25 to 2.25 Gallons per Square Foot per Week**
    * Small herbs to Alfalfa. 75% efficient
* Inches of Water use * 0.625 = gallons per Sq Ft
* Efficiency: 65% to 90% for Sprinklers
* 1,000 Sq Ft total of Row Crops = 1250 to 1750 gallons/week
* 1 Acre of Pasture = ~70,000 gallons/week

Drip Irrigation



http://extension.oregonstate.edu/sorec/sites/default/files/drip_irrigation_em8782.pdf

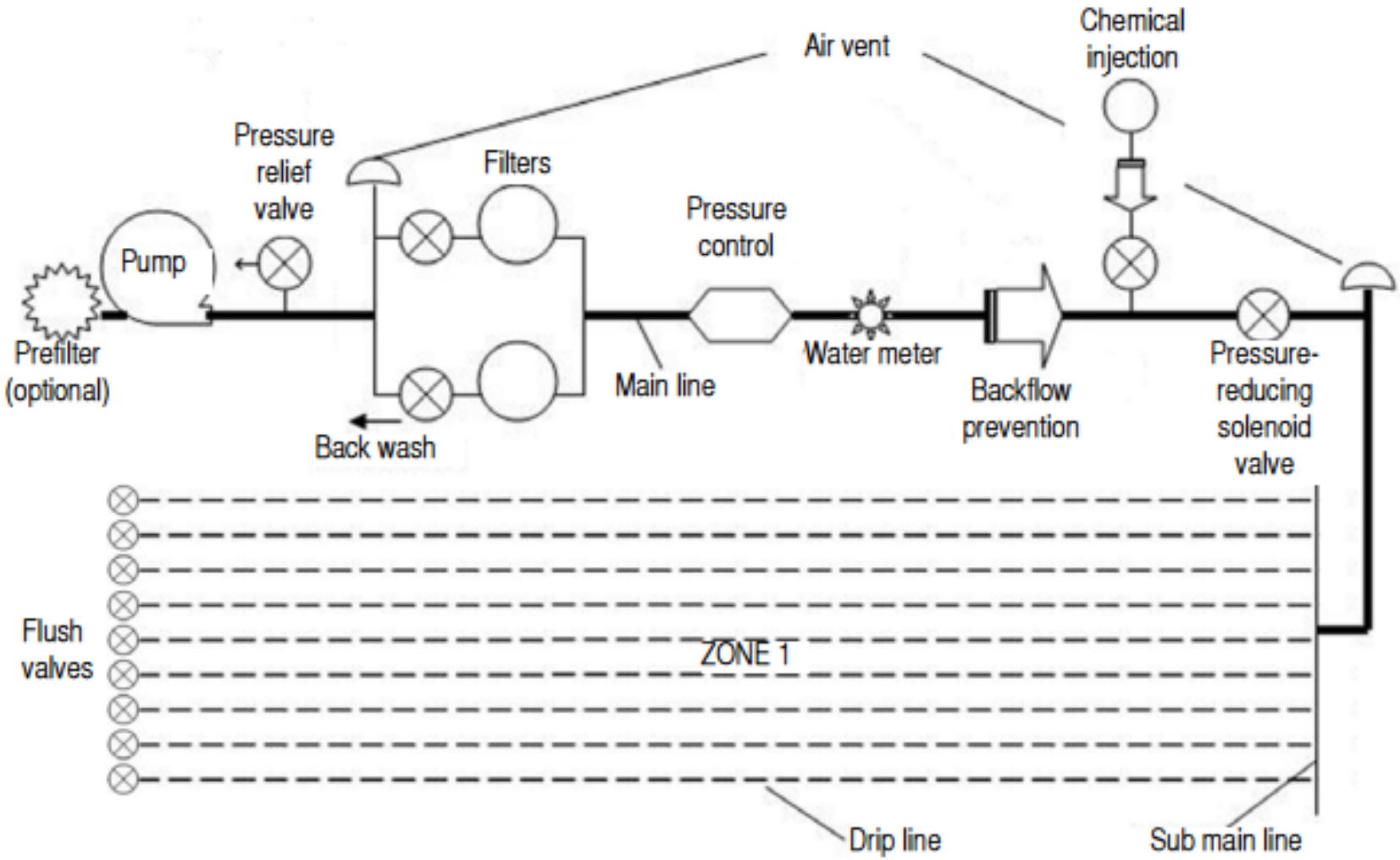
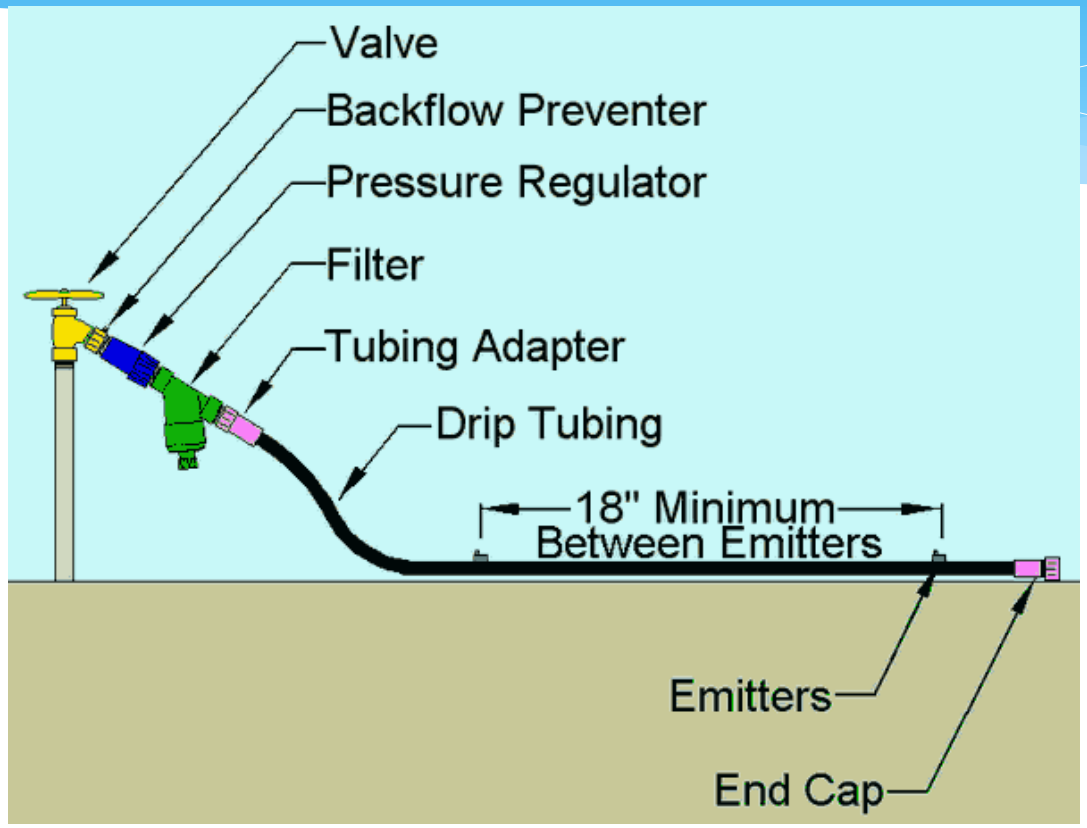
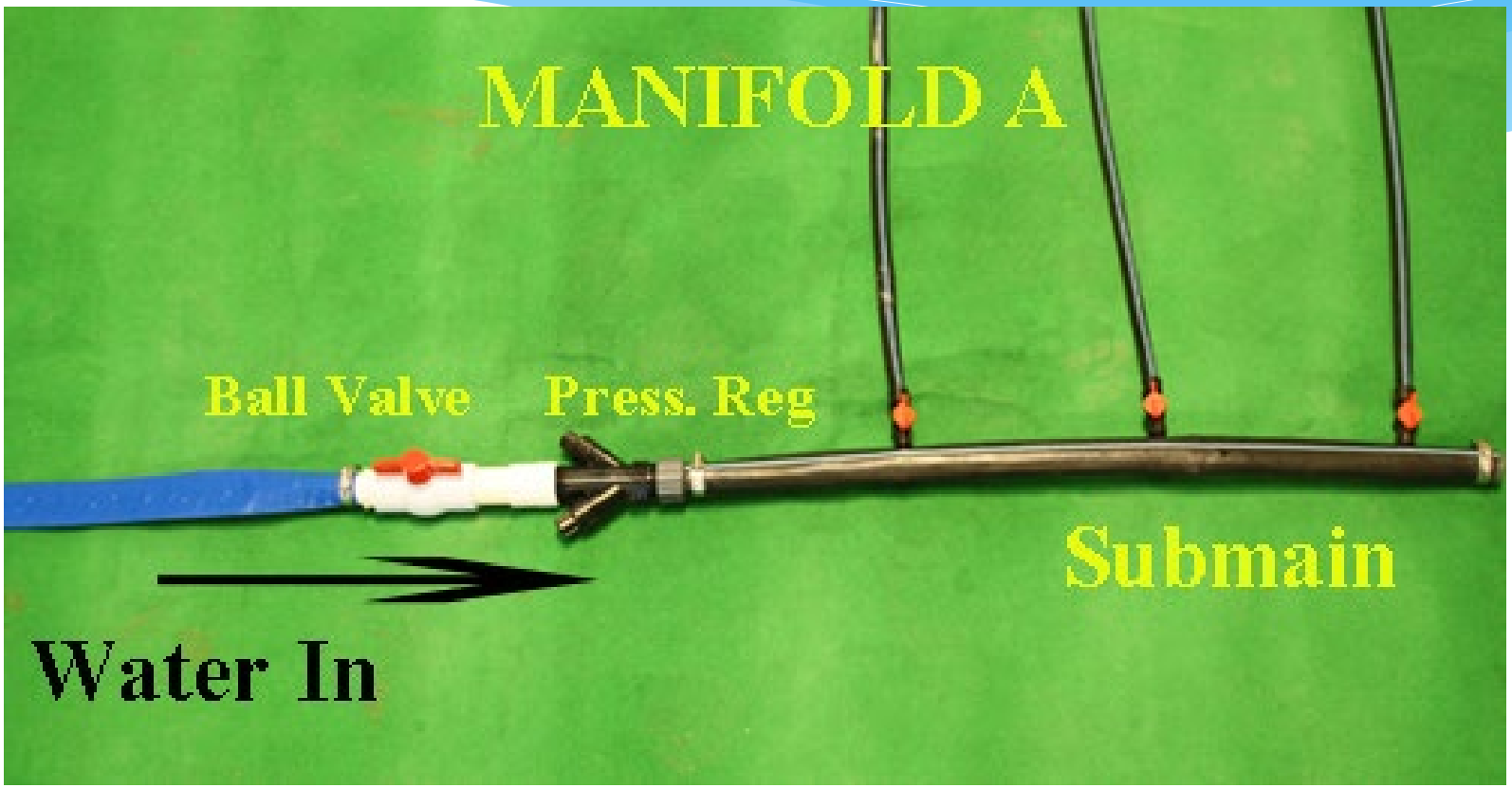


Figure 1. Drip irrigation system with a prefilter, pump station with backflow prevention, and chemical injection site. A pressure control valve is recommended to adjust the water pressure as desired before it enters the drip lines. A water meter can be placed after the pressure control or between a solenoid valve and each zone. An air vent provides vacuum relief. Vacuum relief is necessary between the solenoid valve and the drip tapes to avoid suction of soil into the emitters when the system is shut off.

Drip Irrigation Typical Components



Drip Line Components



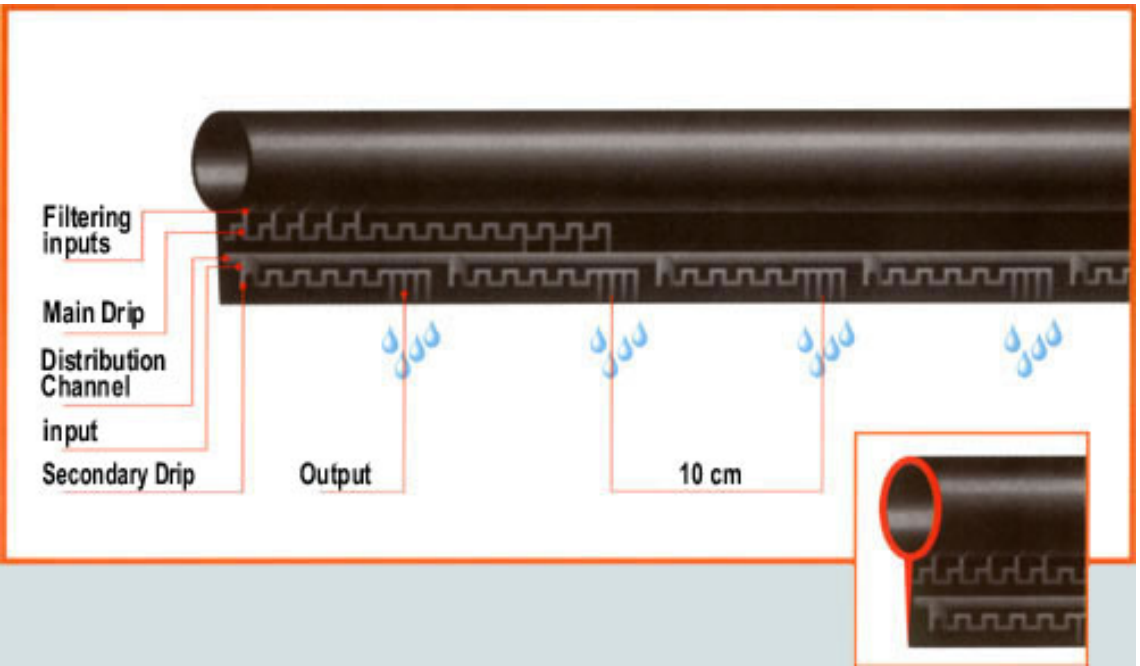
Drip/Trickle Irrigation

* Drip Tape (flat)
* Drip Line (emitters built in)
* Emitt

Drip/Trickle Irrigation

Emitters

Diaphragm allows the same flow rate over a range of pressures.



Tape

Torturous Path reduces flow variations caused by pressure differences


09/22/2014

Row Crop Drip Above Ground

Row Crop Subsurface

Drip Filtration

Screen Filter and small Disk filter
General filtration for Garden/Greenhouse

Media Filter
Large Area best for Organic matter

Drip Filtration

Disk Filters
Good for water with high sand, and sediment and low organic matter (Well water)

Drip Filtration

* Most are at least 100 Mesh (150 Micron)
* Filtration requirement is usually Specified on Drip tape, or drip emitter manufacture brochure, or manufacture website
* Not a bad idea to go to a higher Mesh, 200 or 300 Mesh. (80 or 50 micron)

Water Volume (High Efficient Drip Irrigation)

* Volume is determined by Crop water use and sprinkler efficiency.
* Good Rule of Thumb For Hottest Weeks=
  * **1.0 to 1.9 Gallons per Square Foot per Week**
    * Small herbs to Alfalfa. 90% efficient
* Inches of Water use * 0.625 = gallons per Sq Ft
* Efficiency: 85 to 90% for Drip
* 1,000 Sq Ft total of Row Crops Vegetable = 1000-1900 gallons/week

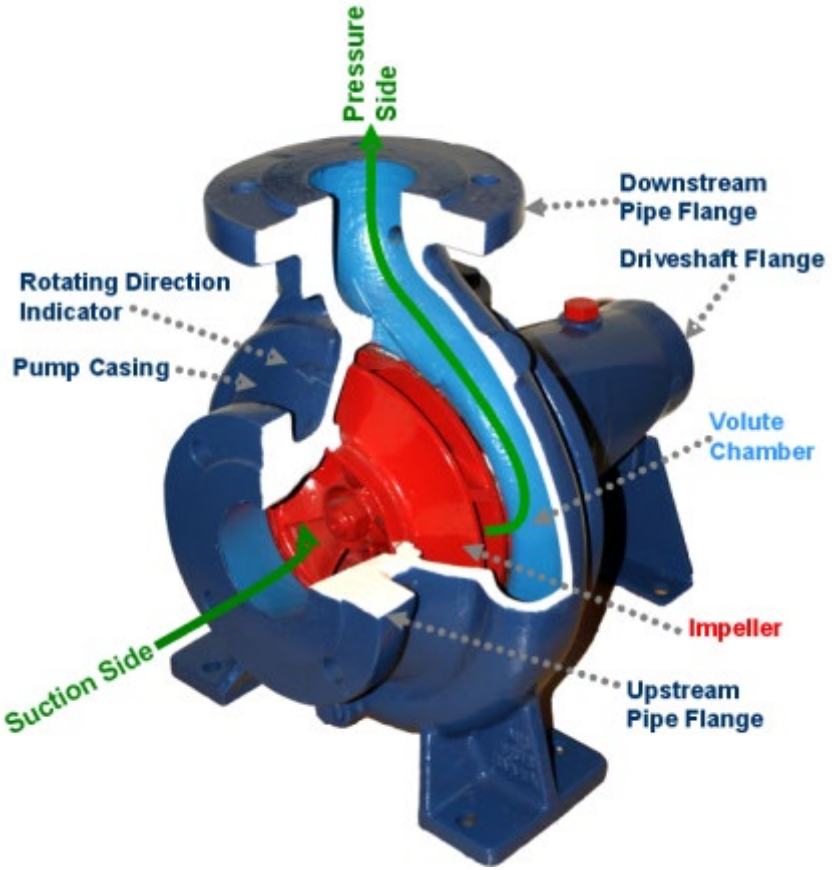
PUMPS

End Suction Centrifugal

Submersible Turbine
(Well Pump)

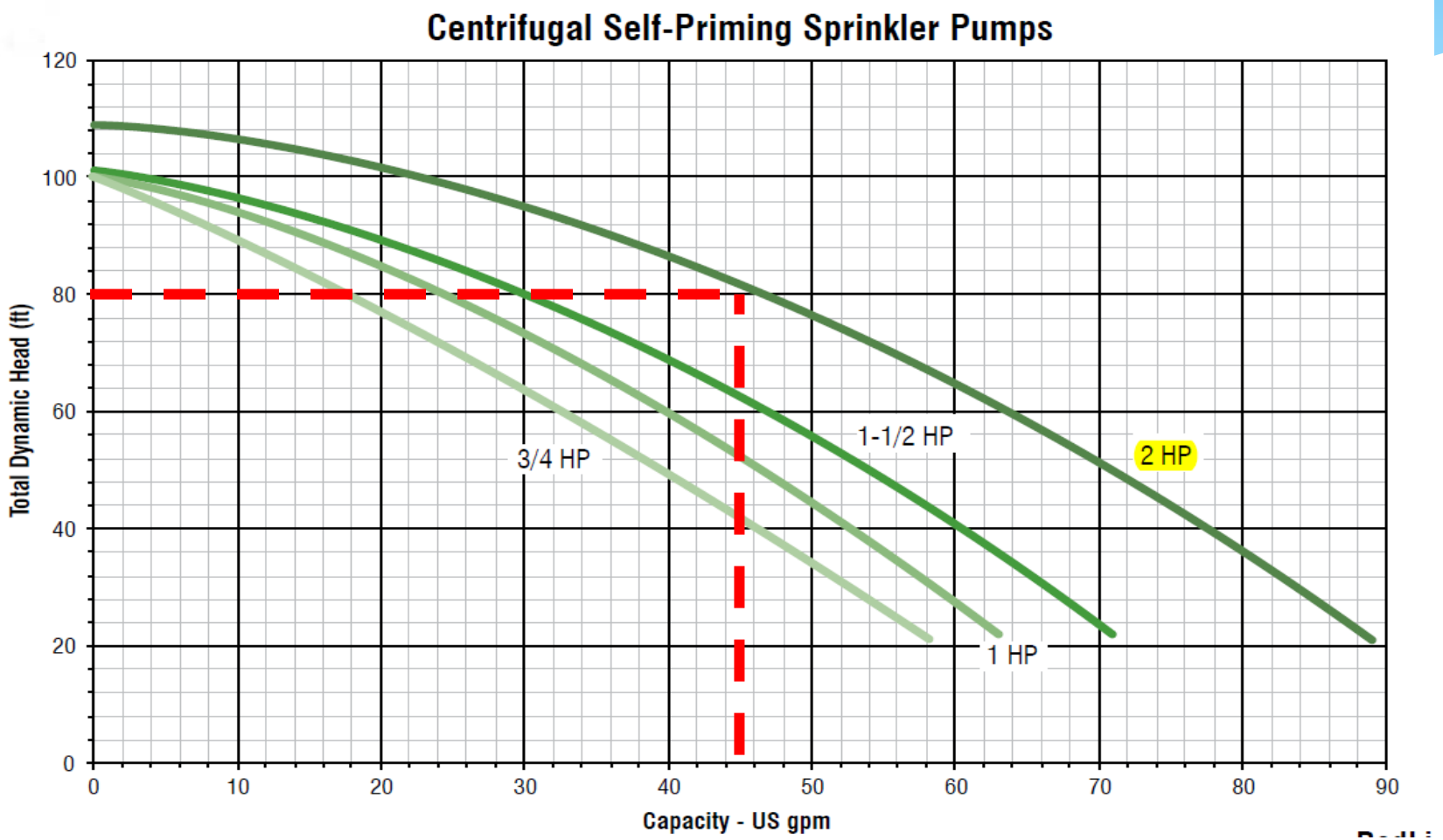
Vertical Turbine

CENTRIFUGAL PUMP

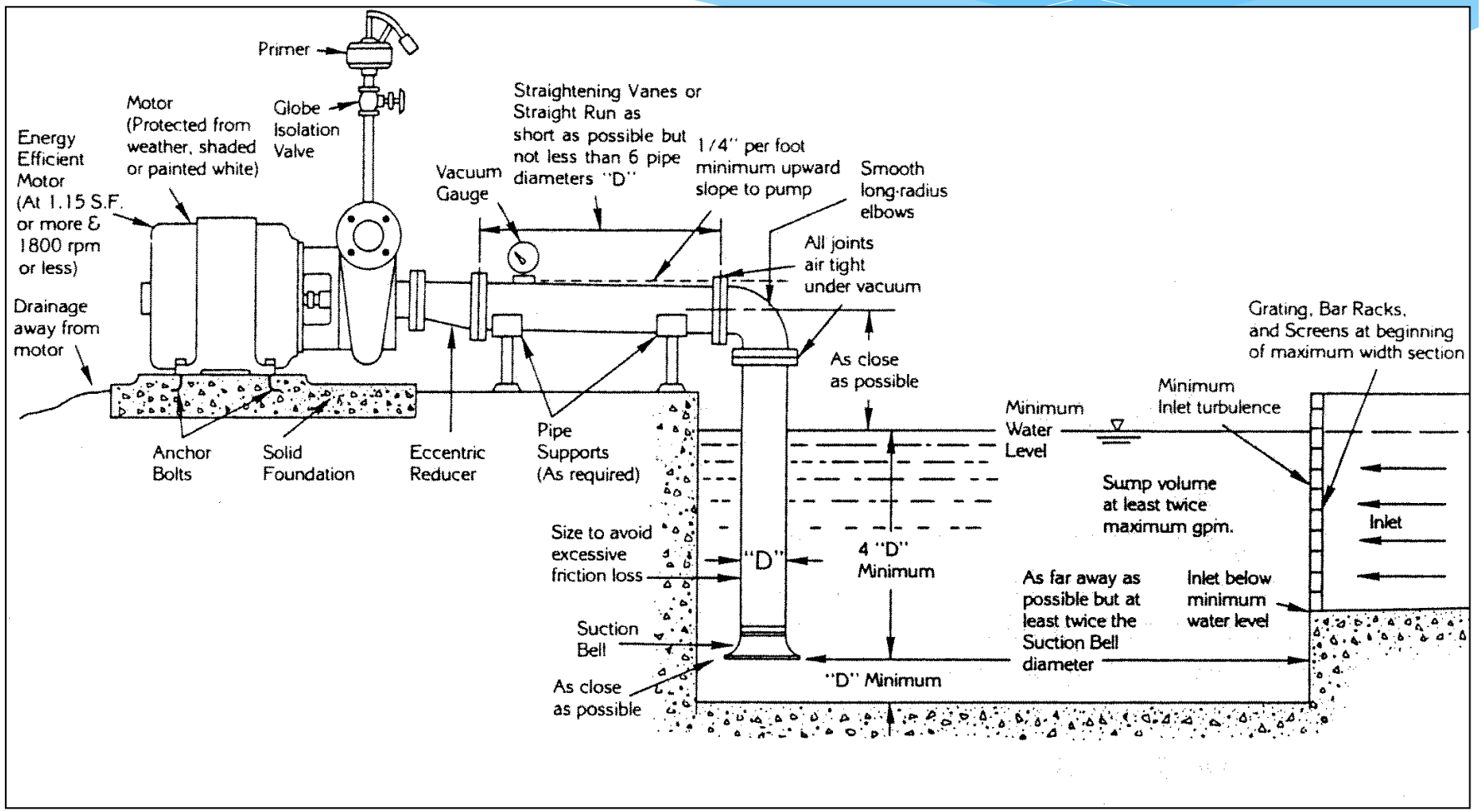


* The motor turns a drive shaft which is attached to an impeller in the pump.
* The rotation of the impeller creates the pressure and flow rate

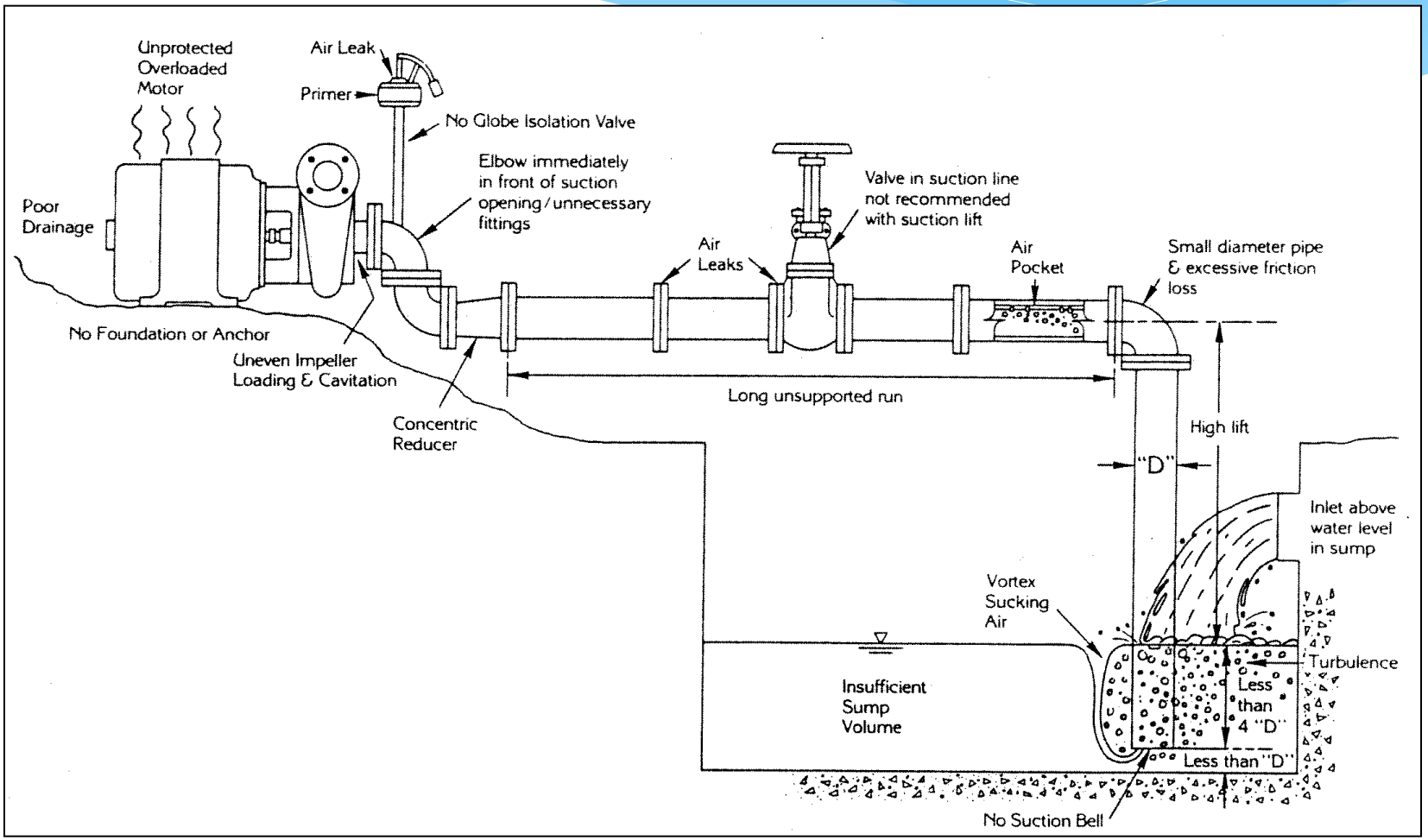
CENTRIFUGAL PUMP CURVE



RECOMMENDED INSTALLATION



INSTALLATION NOT RECOMMENDED



PHOTOS OF INSTALLATIONS


10/16


10/1


05/14/2014


05/02/2015 10:09

PRESSURE TANKS

* Allow the pump to always be 'on'
* You can open the valve in the field, and the pressure in the tank will provide water, then will automatically turn on the pump
* Pressure set points to turn on and off pump / well
* Keeps system under pressure
* Good for gardens, landscape, a couple sprinklers, submersible pumps, domestic wells. About an Acre of irrigation +-

IRRIGATION COSTS

* Capital Cost
  * New Pump, power to pump, pipe and sprinklers
  * $2 - $10+ thousand per acre (economy of scale)
  * Quotes are FREE from irrigation contractors
* Installation Cost
  * May be as much as the total cost of the pipe materials
* Operating Cost
  * Pumping Cost ~ $100 per Acre per Year
  * 2% of sprinkler and pump cost = Annual maintenance cost

Improvement Options

* Start with what you want to irrigate?
* Find a local contractor or other experienced professional to talk to about site specific recommendations and estimated costs
* If the irrigation project is also improving water quality and water quantity in nearby streams, funding and grants may be available. Such as switching from flood to sprinkler.
  * Expect a time delay and additional planning to get public funds
  * Public funds and grants require a higher level of oversite on installation in order to ensure the project will last

Improvement Options

* Grants typically won't cover the entire project cost. Consider your budget. How much are you willing to spend on a new irrigation system?
  * Expect to pay thousands per acre for on-farm improvements.
* NRCS is major funding source for on-farm irrigation improvements. Through the EQIP program. Other funding can add onto NRCS funding.

Improvement Options

* Can my existing flood irrigation system be reviewed and tweaked to save labor and improve yields and reduce runoff?
  * Yes
* What part of the system gives you the most grief and is a time suck? Failing headgate, leaky section, pump suction line? Start by fixing that, then move onto the next piece. This is an economical way to improve the system without having to get a new and expensive system.

Improvement Options

* Who is the irrigator and do they have more or less time to spend on irrigation management?
  * Flood irrigation efficiency can increase dramatically with more active irrigation and continual maintenance.
* Don't spend 80% of the time trying to irrigate the worst 20% of your field. Particularly true with flood irrigation.
* Trying to get water to the 20% dry spots sometimes leads to over-irrigation of the other 80%. Over-irrigation is just as bad as under-irrigation
* Its OK to only irrigate those dry spots once every 5 years if it means saving labor and improving the irrigation on the rest of the field.
* Be effective and efficient with irrigation time

Questions and Discussion

* Thank you for allowing me the opportunity to speak with you!

* We are here to support you in your effort to be more efficient and effective with your irrigation.

* Paul DeMaggio. Paul.demaggio@jswcd.org
  * 541-630-0285
* Meghan Montgomery. Meghan.Montgomery@jswcd.org
  * 541-630-0362