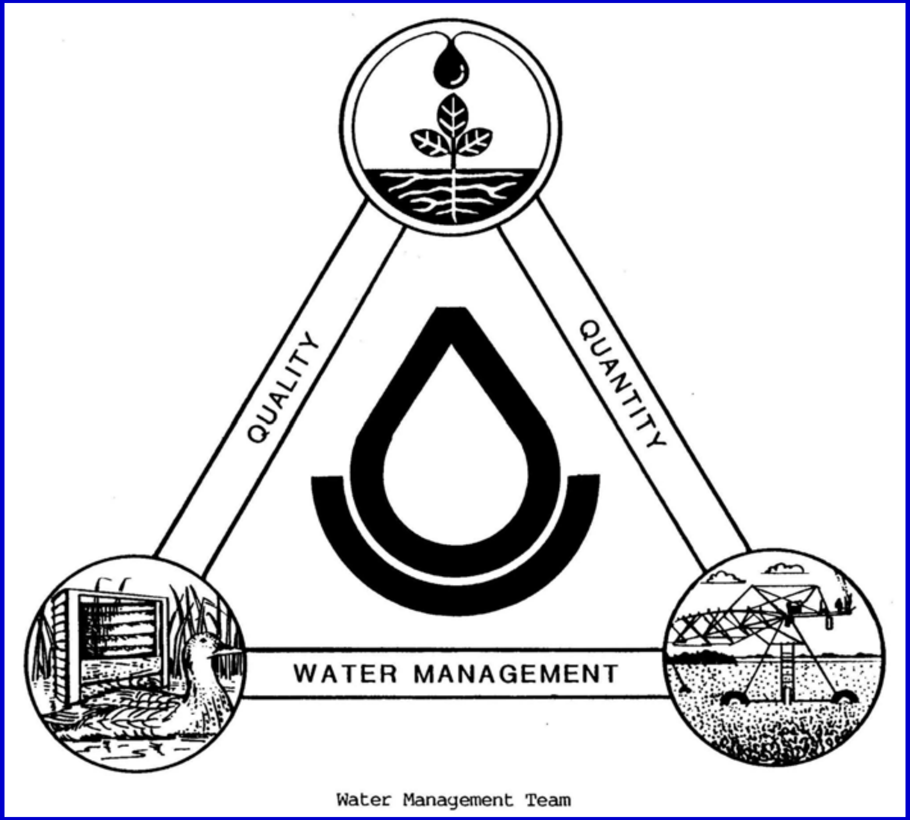
Turn Row Conservation
Irrigation 101



Natural Resources Conservation Service
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USDA

Repetition

- Good for learning, hear three times

Disclaimer

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- NRCS does not restrict the use of conservation practices by product/brand/manufacturer/supplier.

- As long as a product meets practice standards and specifications it can be utilized by a cooperator.

- Some products (new/non-typical) may require additional approvals for use.

Definitions/Terms

gpm = gallon per minute (1600 gpm for 40 acres, typical surface irrigation)

cfs = cubic feet per second (4 cfs for 40 acres, typical surface irrigaition)
1 cfs = 450 gpm

Acre (ac) = 43560 sqft
1 ac-in = 27000 gallons (1 cfs for 1 hour = 1 ac-in)
1 ac-ft = 12 ac-in = 324,000 gallons

Head = equivalent height of water from elevation change, friction losses in pipeline, water table decline, etc.

Water horsepower = (head x gpm)/3960
example WHP = (100 ft x 1600 gpm)/3960
= 40 WHP

Energy Hp = WHP/(pump efficiency*motor efficiency)
= 40 WHP/(0.75 * 0.65)
= 83 HP in energy/fuel

Rules of Thumb

Hydrant

Irrigation needs:

- 0.25 in/day (cotton, early beans)
- 0.30 in/day corn

Water capacity:

furrow= 10 gpm/ac based on 0.25 in/day
sprinkler = 5 gpm/ac “ “
drip = 2 gpm/ac “ “
flood/border = 15 gpm/ac “ “

Pipeline sizes:

1200 gpm = 10” (1 ft/100 ft head loss)
1800 gpm = 12” (0.7 ft/100 ft head loss)
2800 gpm = 15” (0.4 ft/100 ft head loss)
4100 gpm = 18” (0.4 ft/100 ft head loss)

Well sizing = 0.30 in/day* 4 days * 160 acres
= 192 ac-in in 4 days
192 ac-in * 27000 gallons/ac-in = 5184000 gal
4 days* 22 hrs/days*60 min/hr = 5280 min

Well size = 5184000 gal/5280 min = 982 gpm/eff
= 982 gpm/0.60 furrow eff = 1630 gpm
= 982 gpm/0.85 sprinkler eff = 1155 gpm

Irrigation (its not rocket science)

- **must add to net profit per acre** (in SE tends to be insurance against failure)

- in Southeast, must pay for itself in 2 years in 5

- soil health will ultimately determine effectiveness and efficiency of irrigation

- irrigating in SE is harder than most irrigation regions because of our rainfall

- what has been developed out west and in mid-west won't necessarily work in SE

- only save water if pumping time is reduced

Irrigation Water Management

- when does the crop need water (scheduling, soil moisture sensors)

- how much water does it need (soil water holding capacity, plant stage)

- how can I apply the water (type, capacity)

(If water is cheap and plentiful, irrigation can be inefficient,
no major impact on bottom line, so tend to overuse)

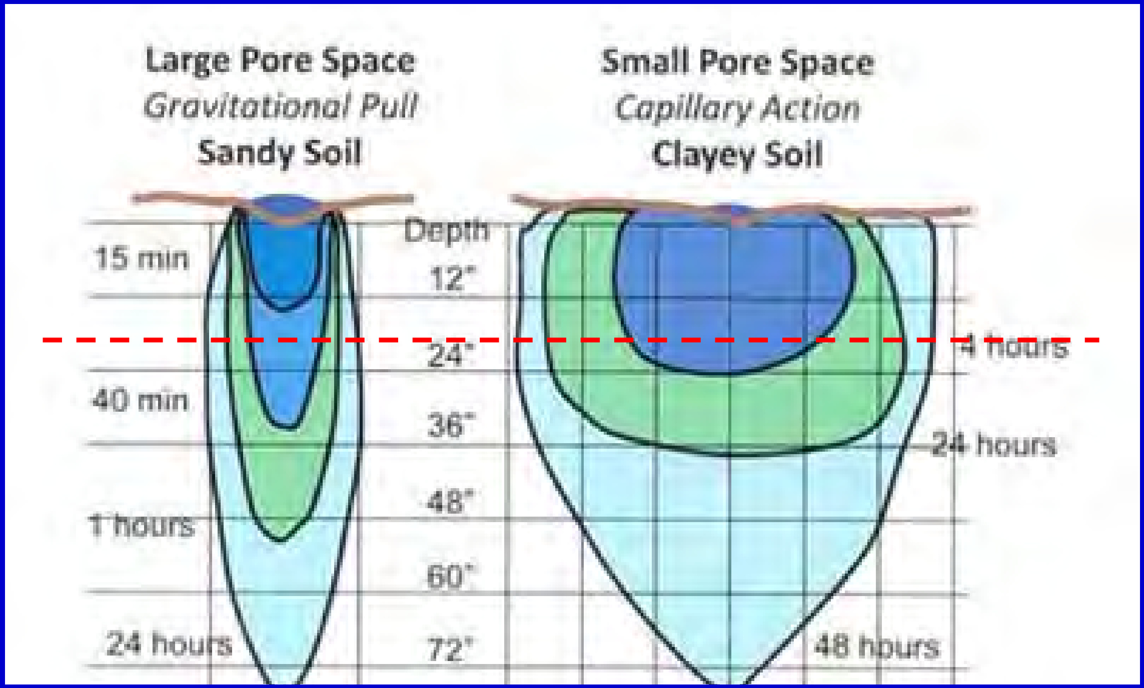
Sites for Irrigation Information

https://sites.google.com/site/msdeltairrigation/

http://irrigationtoolbox.com/

https://www.youtube.com/watch?v=DmTNFIEc2VA
(How water moves through soil, original, best, many versions on web)
If you do one thing after this training, watch this video!!!

Topics to learn
1. ***Soil***-Water-Plant Relationship
2. Irrigation System Planning
3. Irrigation System Design
4. Water Measurement
5. Irrigation Scheduling
6. Soil Moisture Measurement
7. Irrigation Water Management
8. Irrigation System Evaluation



Don't believe everything you see!!

“Those who cannot remember the past are condemned to repeat it.”

George Santayana: philosopher, essayist, poet and novelist

e.g. learn the history of what you are involved with

6000 BC Irrigation began- retaining river floods

3500 BC Nilometer , Water Level Measurement/staff gage

2000 BC Cement pipe

1792-1750 BC Water Regulations

1700 BC Irrigation Shaduf – first water lifting

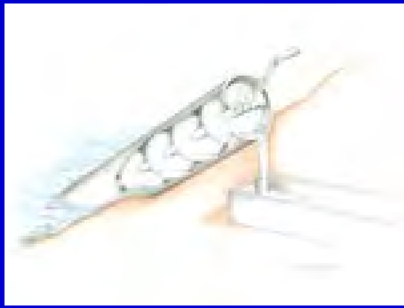
1200 BC the earliest known Native American irrigation system in the Southwest U.S.

700 BC Noria (Egyptian Water Wheel)

550 BC Qanat – first GW well

500 BC Sakia: Persian Water Wheel - The first use of what is now called a pump. Ox-powered

250 BC Archimedes Screw



500 AD Windmills

There is actually very little new in irrigation.
Just new technology applied!

312 BC – first Roman aqueduct. But forms of aqueducts were used earlier (900 BC).

This laid the groundwork for major water delivery systems. (e.g. CA, Midwest)

Early irrigation used open water ditches with siphon tubes to deliver water to the field. **Surge/cutback** systems were first done by starting with multiple siphons (first cycle), then removing siphons (2^{nd}, 3^{rd} cycle), till one siphon remained (soaking flow).

Siphon passes under South Platte River Valley and I-80.

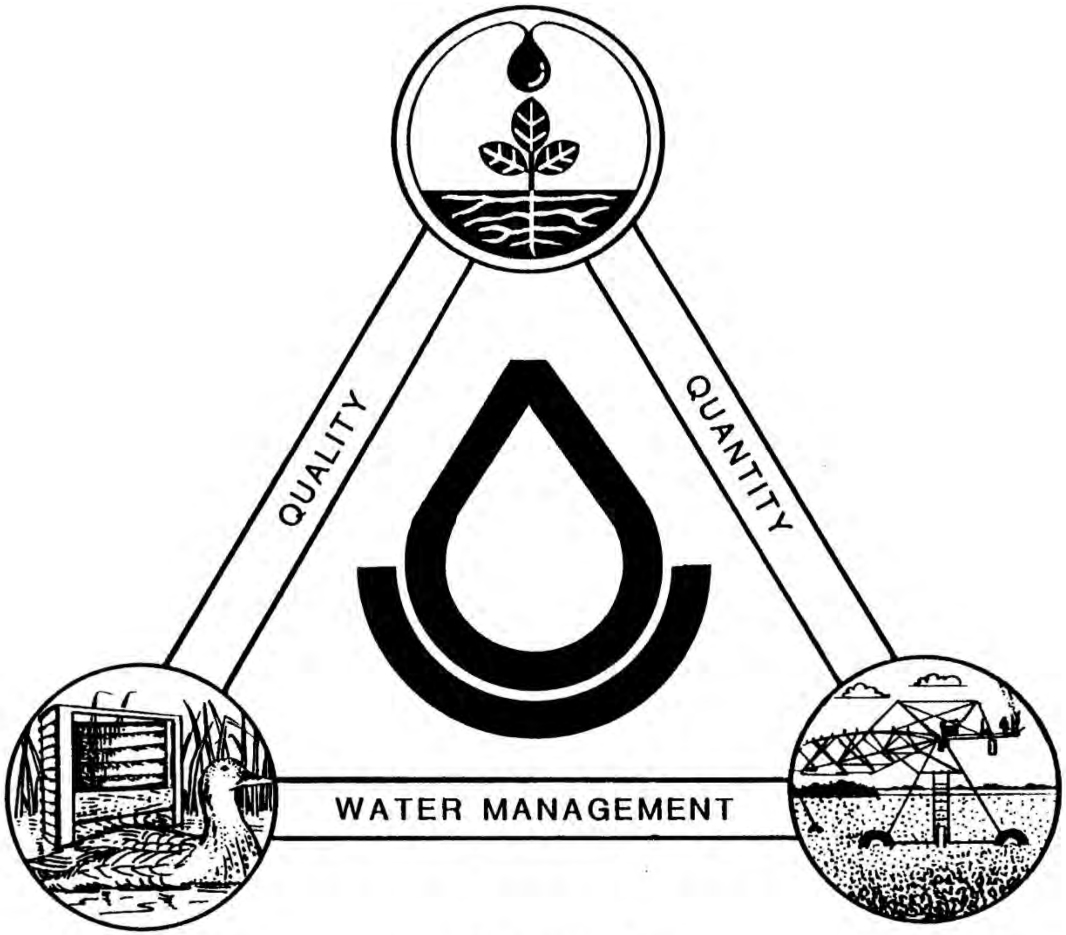
Paxton, NE

Original system dates from 1897.

WATER MANAGEMENT

YEAR END REPORT

FY-1989/1990



Water Management Team

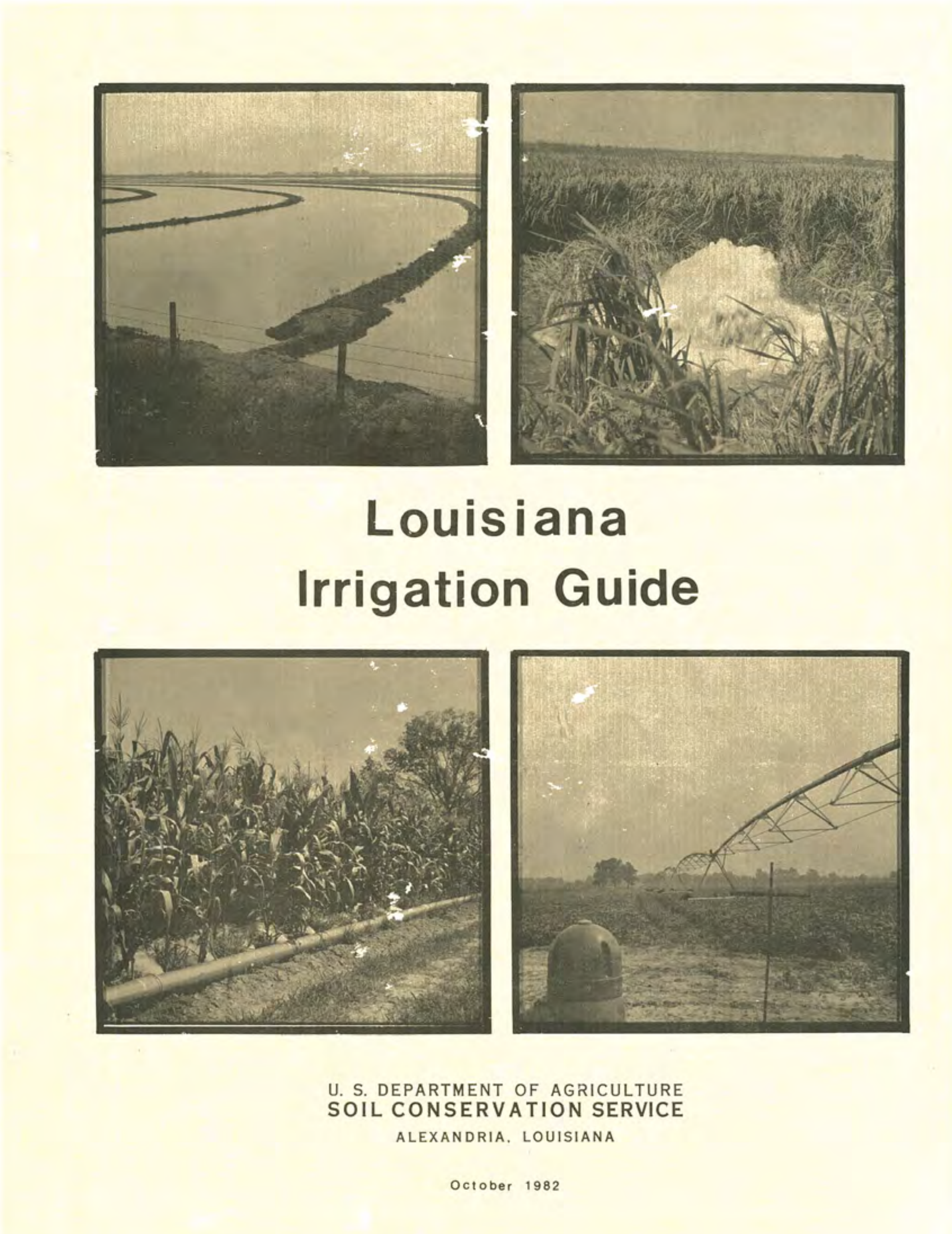
United States Department of Agriculture
Soil Conservation Service
Area I , Mississippi

1986-1992 NRCS
Irrigation Water Management Team

- Annual reports
- Center Pivot Evaluations (51)
- Pumping Plant Evaluations
- Furrow Evaluations
- Rice Evaluations
- Irrigation Scheduling
- Infiltration studies
- 6/3 Method for Aquaculture
- Permanent pads for rice
- Flowmeters
- Side/multiple inlets
  (Rainfall harvesting in rice)
- Winter flooding for wildlife and
  sediment control
- Visited TX, AR, NE to learn from their experience

1986 – NRCS (then SCS) got first desktop computers. DOS

No Windows, WORD, POWERPOINT, EXCEL.


Louisiana
Irrigation Guide

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ALEXANDRIA, LOUISIANA

October 1982

Basics have not changed.

What has changed is the HOW:
- polypipe vs rigid gated pipe
- electronic vs manual
- automated vs manual
- telemetry (remote monitoring and control)

NEXT STEP: AI
- Artificial Intelligence system will receive data, make decisions, and operate system.

- Management is weakness in chain to achieve full conservation benefits

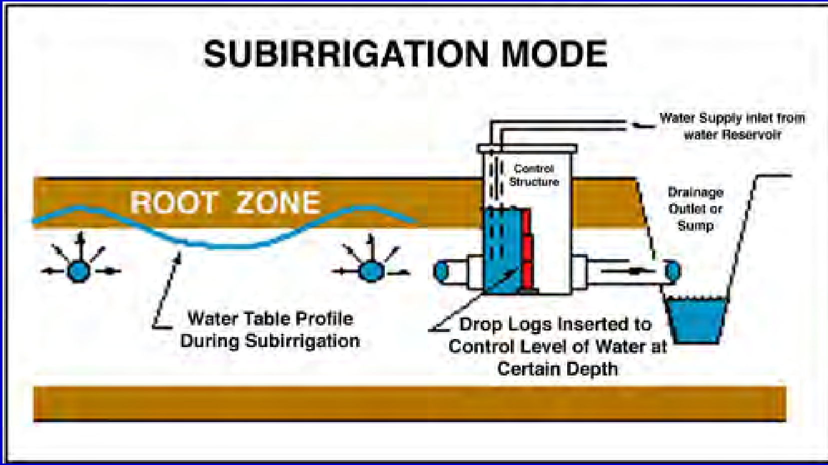
History:
GOSSYM-COMAX
growth simulation model/expert management system
for cotton production

Four basic irrigation methods:

Surface (***furrow***, ***flood***, border)

Sprinkle (***Center Pivot***, side-roll)

Micro (***drip, trickle***)



Subirrigation

(water table management)

Irrigation
Soil-Water-Plant
Relationship

Plant

- water use (transpiration): cooling, nutrient transfer, cell processes
- Can extract water from soil down to -15 bars (wilting point)
  1 bar = 14.7 psi
- rooting depth based upon growth stage, soil capability

Soil

- holds water for plant, amount depends upon soil type/condition
- rooting depth important, more depth, more water/nutrients available
- often restricted by plow pans, natural soil restrictive layers, compaction, low organic matter
- should irrigate before soil moisture reached 50% of water holding capacity
  (keeps a reserve for crop if something happens, also typically deficit irrigate, empty soil profile at end of growing season)

Water

- rainfall or irrigation, delivery system
- must be able to move into soil (infiltration vs application rate) or will runoff
- needs to be distributed evenly over field
- water chemistry is important:
  dissolved solids, salts, pH, minerals, temperature

Irrigation and IWM must involve all components of the Soil-Water-Plant relationship

Web Soil Survey

Available Water Capacity

Available Water Capacity— Summary by Map Unit — Washington County, Mississippi (MS151)				
Map unit symbol	Map unit name	Rating (centimeters per centimeter)	Acres in AOI	Percent of AOI
Be	Bosket very fine sandy loam, nearly level phase (askew)	0.15	249.3	24.7%
Bf	Bosket very fine sandy loam, gently sloping phase (askew)	0.15	46.3	4.6%
Bg	Bosket very fine sandy loam, nearly level moderately shallow phase (askew)	0.15	11.3	1.1%
Bh	Bowdre silty clay, nearly level phase	0.18	0.7	0.1%
Ca	Commerce silt loam, 0 to 2 percent slopes	0.21	189.1	18.7%
Cb	Commerce silt loam, 2 to 5 percent slopes	0.21	2.5	0.3%
Ch	Commerce silty clay loam, 0 to 2 percent slopes	0.22	31.3	3.1%
Cm	Commerce silty clay loam, moderately shallow, 0 to 2 percent slopes	0.21	8.7	0.9%
Cn	Commerce very fine sandy loam, 0 to 2 percent slopes	0.22	27.4	2.7%
Cr	Commerce very fine sandy loam, 2 to 5 percent slopes	0.21	2.7	0.3%
Cs	Commerce very fine sandy loam, moderately shallow, 0 to 2 percent slopes	0.21	14.2	1.4%
Da	Dowling clay (sharkey), 0 to 2 percent slopes, occasionally flooded	0.12	106.1	10.5%
Db	Dowling soils (sharkey), 0 to 2 percent slopes, occasionally flooded	0.12	53.8	5.3%
Sa	Sharkey clay, level phase	0.11	0.7	0.1%
Sb	Sharkey clay, nearly level phase	0.11	205.3	20.3%
Sd	Sharkey silty clay loam, nearly level phase	0.13	17.9	1.8%
So	Souva silt loam (commerce)	0.21	3.3	0.3%
Ta	Tunica clay, nearly level phase	0.18	39.4	3.9%
Totals for Area of Interest			**1,010.1**	**100.0%**

Texture Classification	Common Delta Soil Names	Field Capacity	Wilting Point	AWC	Ksat	Irrigation Point 50% AWC	Irrigation Point 50% AWC	K	K
Note: find the soils in your field and their textural classification in WEB SOIL SURVEY		% vol @ 33 cb	% vol @ 1500 cb	(in/ft)	(in/hr)	% Vol	Tension cb	(in/hr) @ FC	(in/hr) @50% AWC
Sand (S)	Beulah, Robinsonville, Crevasse	9.4	5.0	0.53	4.49	7.2	158	0.000000000293	0.00000000002
Loamy Sand (LS)	Beulah, Robinsonville, Crevasse	12.1	5.7	0.77	3.59	8.9	155	0.000000127	0.00000000564
Sandy Loam (SL)	Beulah, Commerce, Dubbs, Dundee, Sharkey, Bosket, Bruin, Tutwiler	17.9	8.1	1.18	1.98	13.0	154	0.0000188	0.000000591
Loam (L)	Dubbs, Dundee, Bruin, Bosket	26.7	12.6	1.69	0.73	19.7	156	0.00062	0.0000156
Silt Loam (SIL)	Askew, Collins, Commerce, Dubbs, Dundee, Oaklimeter, Pearson, Souva	32.1	13.7	2.21	0.48	22.9	150	0.00388	0.0000847
Silt (SI)	Falaya, Waverly	31.6	6.3	3.04	0.75	19.0	111	0.0284	0.000693
Sandy Clay Loam (SCL)	Dundee	28.3	18.3	1.21	0.31	23.3	182	0.0000587	0.0000015
Silty Clay Loam (SICL)	Bosket, Commerce, Forestdale, Sharkey, Tunica, Tensas	37.9	21.0	2.03	0.23	29.5	168	0.00222	0.0000454
Clay Loam (CL)	Forestdale, Tensas, Dundee	35.0	21.3	1.65	0.18	28.2	175	0.000794	0.0000179
Sandy Clay (SC)		37.1	26.0	1.32	0.03	31.6	185	0.00047	0.0000113
Silty Clay (SIC)	Bowdre, Forestdale, Mhoon, Newellton	41.6	27.8	1.66	0.15	34.7	183	0.000804	0.0000149
Clay (C)	Alligator, Dowling, Sharkey,Tunica	42.0	29.9	1.45	0.03	36.0	188	0.000687	0.000014

cb = centibar, 100 cb = 1 bar or 1 atmosphere of soil tension
33 cb is considered field capacity (FC), the point to which soil will drain by gravity alone
1500 cb is wilting point (WP), plants will desiccate at this level
AWC is available plant water in inches per foot of rooting depth between FC and WP
50% AWC is 50 percent of the available plant water (moisture between FC and WP)
Ksat is saturated hydraulic conductivity , in/hr
Soil moisture sensors will typically read in either:

- tension (cb or equivalent). Tensiometric measurement, the physical force actually holding water in the soil.
- % vol (volumetric water content of the soil)

Irrigation should begin no later than the tension (cb) or volumetric water content (% vol) at 50% of AWC. The critical field is the last field to be irrigated from the well, or the last area to be covered by a pivot (e.g beginning of circle, end of circle).

Focus on major textural classification, not individual soil series.

http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Data developed from: Web Soil Survey and SPAW / Soil Water Characteristics
Paul B. Rodrigue, Supervisory Engineer, Grenada, MS; Rachel Stout Evans, MLRA Soil Survey Office Leader, NRCS, Metcalfe, MS

What most farmers know about Irrigation

- *I have a pump, water comes out*

- *I have a delivery system, it goes into the field (and out)*

- *I put water on my crop if it doesn't rain (or if my neighbor irrigates)*

What most farmers DON'T know about Irrigation

- how much water my pump puts out (no flowmeter, no pump curve)
    - in MS only 10% of 22,000 wells have meters (and not all those are correct)
    - what are my static and dynamic/pumping water depths
    - how much energy do I use to pump and ac-in of water
- what is the water holding capacity of the soils in my field, what is the 50 % mark
    - what is the infiltration rate of my soil
    - how long do I need to irrigate to reach my target
- when and how much should I irrigate - Irrigation Scheduling
- how successful was my irrigation and when will I need to irrigate again

10% early adopters, 60% skeptics, 20% late arrivals, 10% bankrupt

Above: atmometer for measuring ET. Mimics crop.

Components of an irrigation System

- Water source: groundwater, surface water

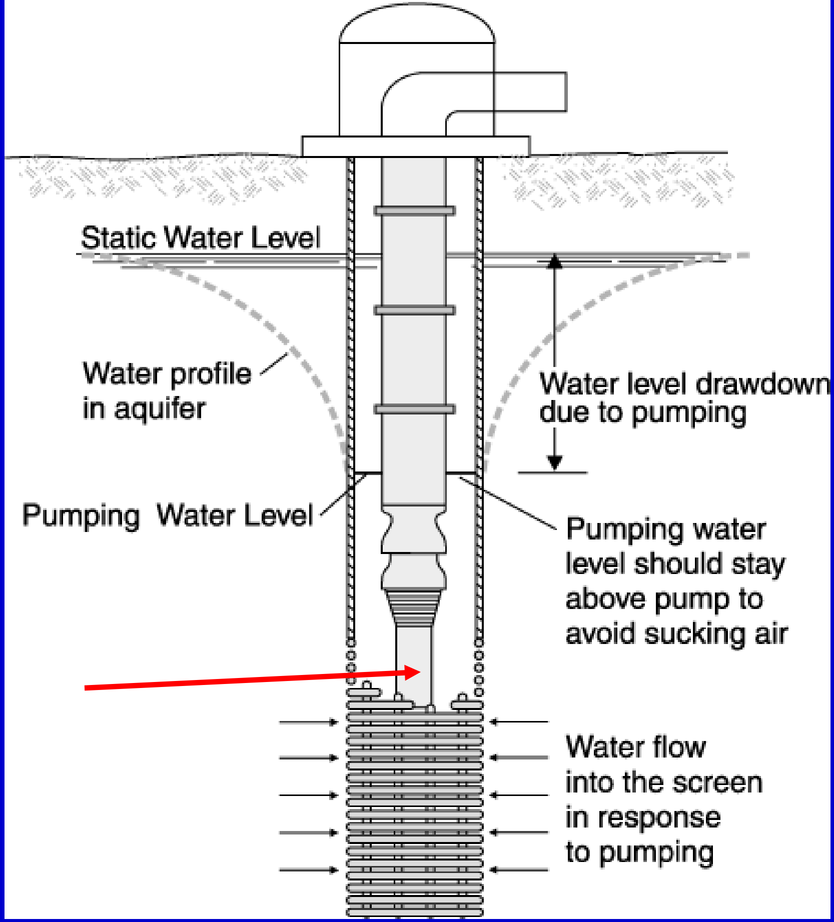
- Pumping system:
    - flowmeter
    - gw: well, pump, power unit
    - sw: pump support, pump, power unit

- Water Conveyance:
    - open channel
    - pipeline

- Delivery System
    - furrow: polypipe, rigid gated pipe, flume/siphons
    - flood: direct discharge (flow-through), polypipe (multiple/side inlet)
    - sprinkler: center pivot, linear move, side-roll
    - drip/trickle: drip line or tape

Well and Components

- drilled hole
- casing
- bentonite seals (isolate different aquifers/layers)
- well screen
- gravel pack



Water level

- static (non pumping)
- dynamic (pumping) seldom measured (1 ft of drop per 100 gpm is desired)
- well causes "cone of depression" and irrigation season progresses

Issues:

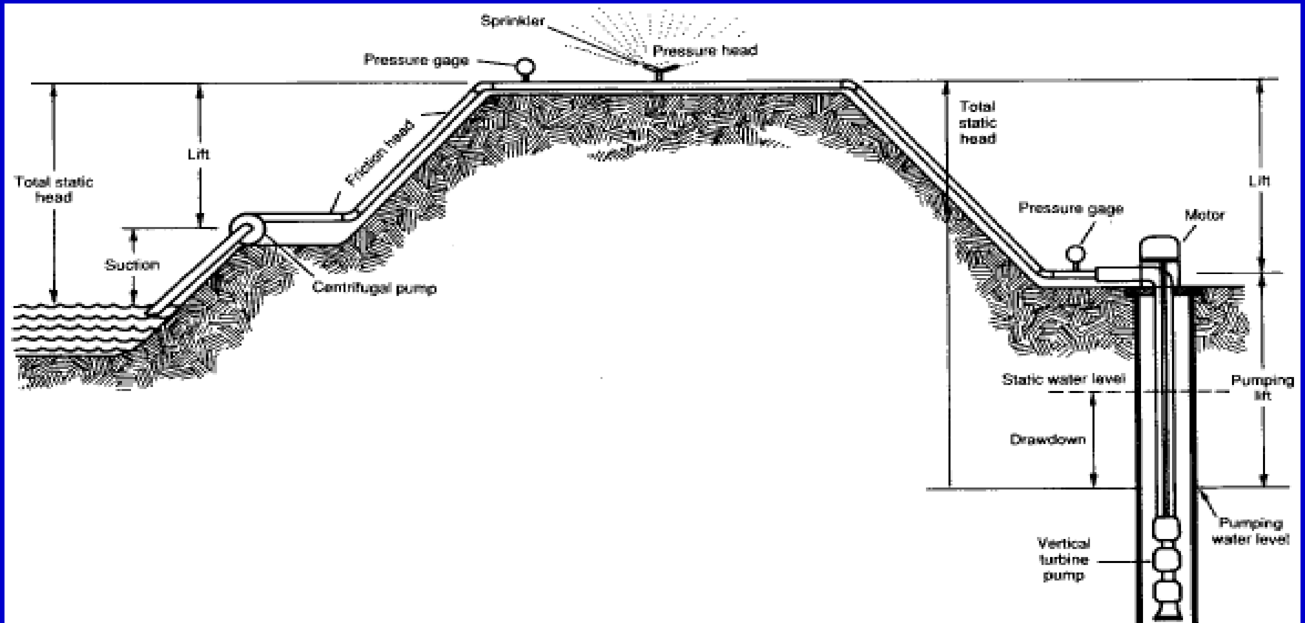
- poor design/construction/maintenance
- aquifer/screen clogging: iron bacteria is a big issue
- standard muratic acid treatment does not address iron bacteria
- dissolved iron is what makes pivots look rusted

Red arrow points to "stovepipe", an extension that allows pump stages to be higher in system, allowing for less pump column ($$), but placing intake in screened area. Does not create suction lift.

Pumps, Types and Components (terminology varies)

- centrifugal
  - closed impeller (deep well <u>turbine</u>, groundwater) - high head, high flow
  - semi-closed impeller (surface water) - medium head, highest flow
  - open impeller (surface water)
  - centrifugal pumps typically use “suction” lift – pump intake above water
    can only be about 20 ft above water surface, <u>priming requirement</u>
- axial
  - propeller (drainage) - high gpm, low lift (head)

Pumps -
  - diameter (flow)
  - stages (increase in stages increases head produced, no flow change)
  - pump column (water flow to surface discharge)



Centrifugal - Camelback

Turbine- 5 stages

Centrifugal – suction lift

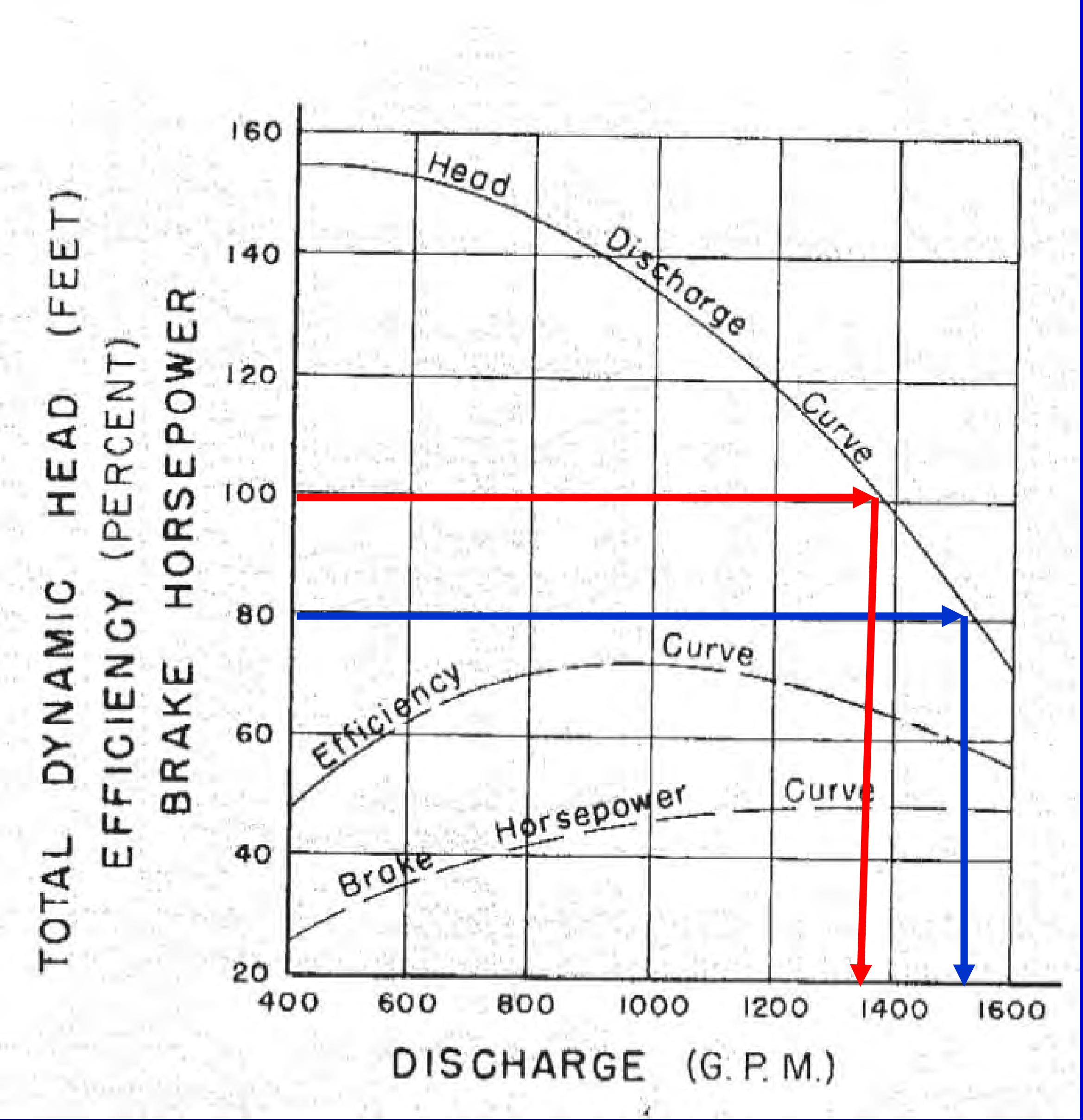
Centrifugal - floating

Camel back with dedicated power unit.

Ideal for surface water utilization. High volume, low lift.

Tractors are seldom efficient matches to pump requirements

Pump Curves and Rules



- more head (water table decline, friction loss), less gpm

- few wells allow water table measurement, no access port or airline

Blue: 80 ft head, 1550 gpm

Red: 100 ft head, 1375 gpm

Each pump curve is individual

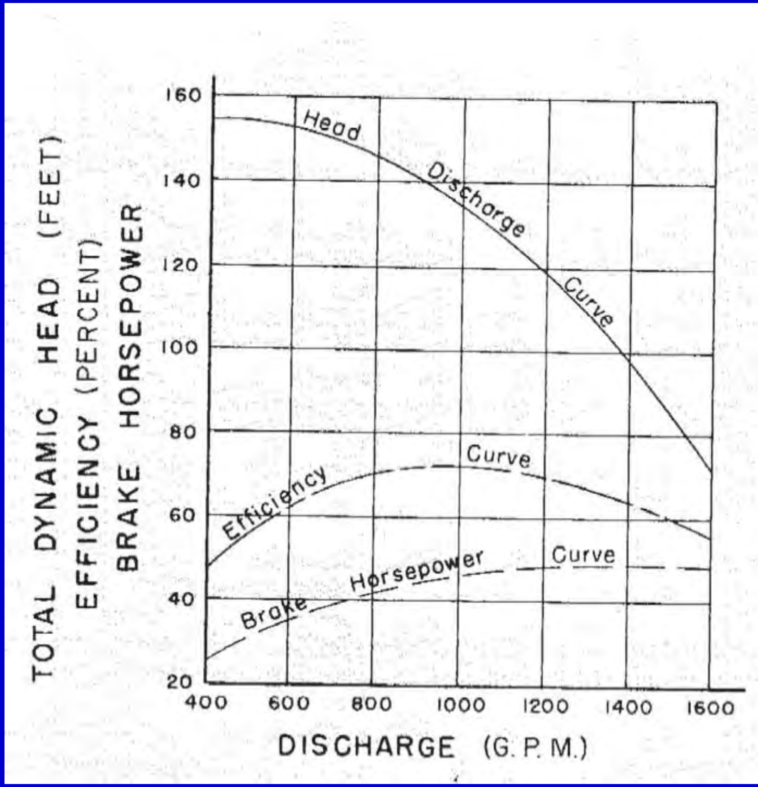
stages (bowls) increase head, not flow

Head increases - increase # stages to offset

Pumping Plant Evaluations

- little value unless pumping from >250 ft or fuel >$5.00 gallon
- cost versus benefit too low, so in MS Alluvial Aquifer, little benefit
- farmers should have pump curve for each well (and flowmeter)

- more head (water table decline, friction loss), less gpm
- few wells allow water table measurement, no access port or airline, can't evaluate



Furrow Irrigation and Components

Water Source: surface, groundwater
- screening

Pump - flowmeter

Underground line and riser with hydrant/direct connection

Distribution line - polypipe

Furrow flow rate

Irrigation set time

Tailwater requirement (to water bottom of field sufficiently)

<u>Increasing Efficiency</u>

- Crop rotation/cover crops/residue management/reduced tillage
  (increase and maintain organic matter, increase infiltration rate and water holding capacity, increase rooting depth, greater rainfall capture)
- Timer/remote operation of well
- Polypipe hole sizing (increases distribution uniformity, decreases tailwater time)
- Soil Moisture, irrigate based upon soil moisture and crop growth stage
- surge irrigation/automated risers - reduce tailwater requirement

Hole puncher, plugs, and gates for poly-pipe.

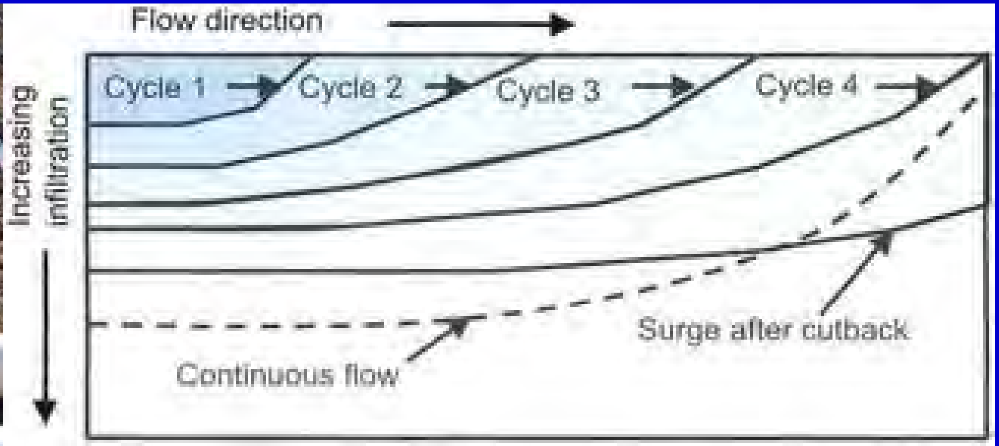
Some have 2 sizes, some 4, on punchers

left:

Punch holes based upon PipePlanner hole-sizing.

Increases distribution uniformity, furrow gets correct gpm.
Pipe should be round, not oval.

Surge Valves/Automated Risers



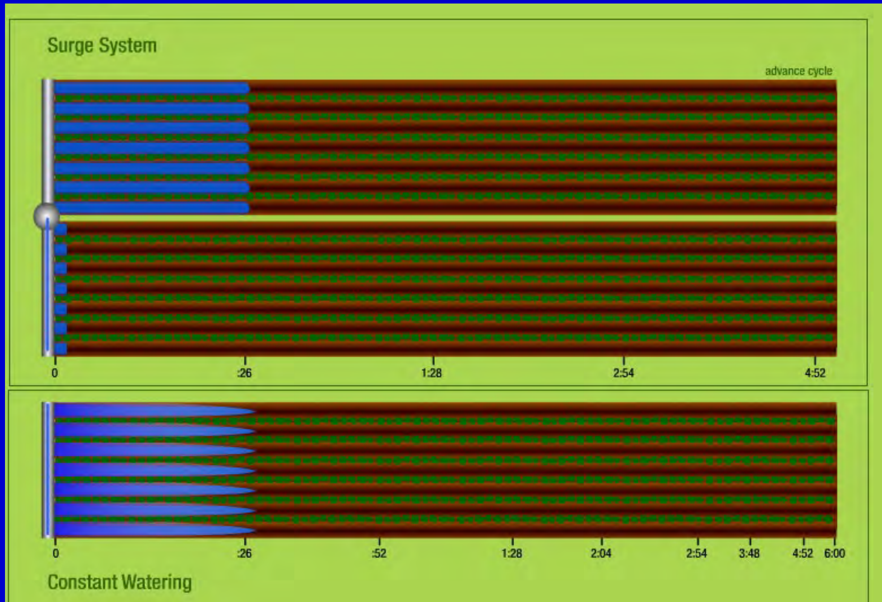
- cutback schemes have been used for ages. Technology makes easier.

- pulse water to separate parts of field to increase infiltration and decrease tailwater

- needed on our high silt content alluvial soils (low infiltration and water holding capacities)

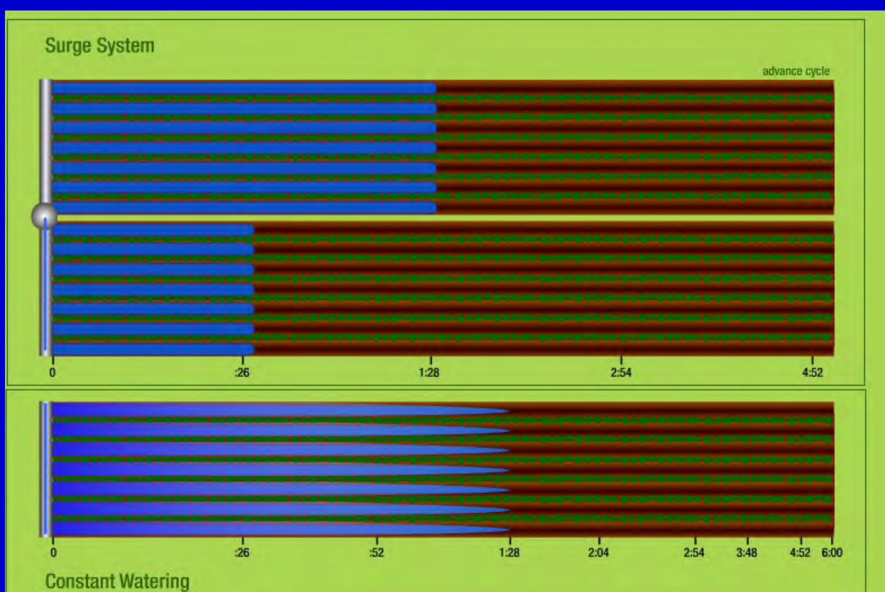
- requires a good bit of record keeping and management to get benefits

<u>- the better the soil health, the more beneficial and easier surge valves are</u>



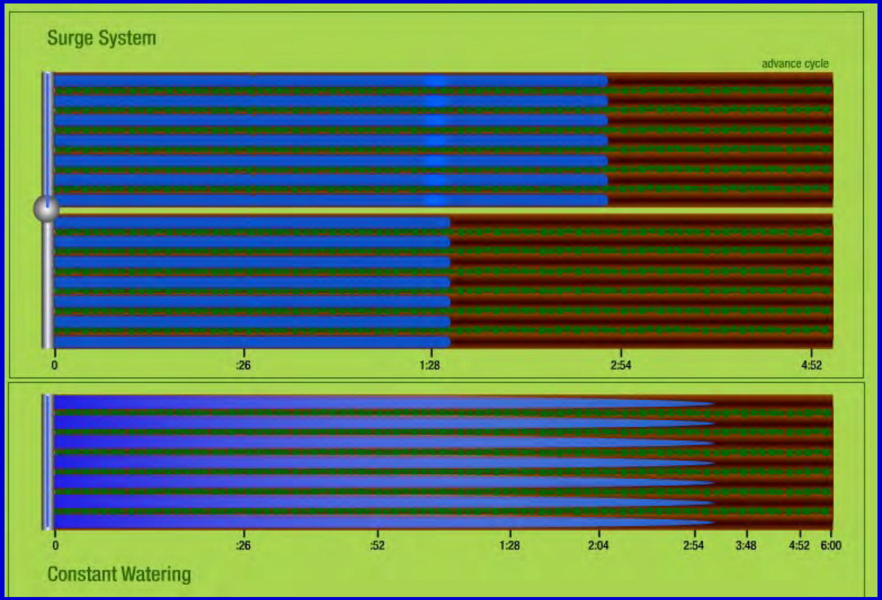
Surge: pulse 1 to field 1 finished, pulse 1 to field 2 beginning.

Constant: water is advancing across entire field/



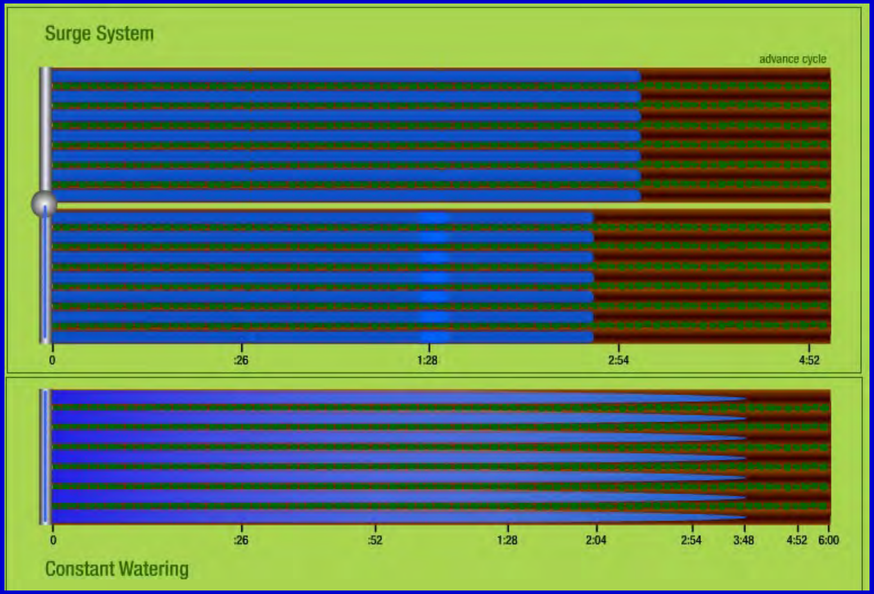
Surge: pulse 2 to field 1 finished, pulse 2 to field 2 beginning.

Constant: water is advancing across entire field. Top of field has now had double the irrigation time as the surge fields.



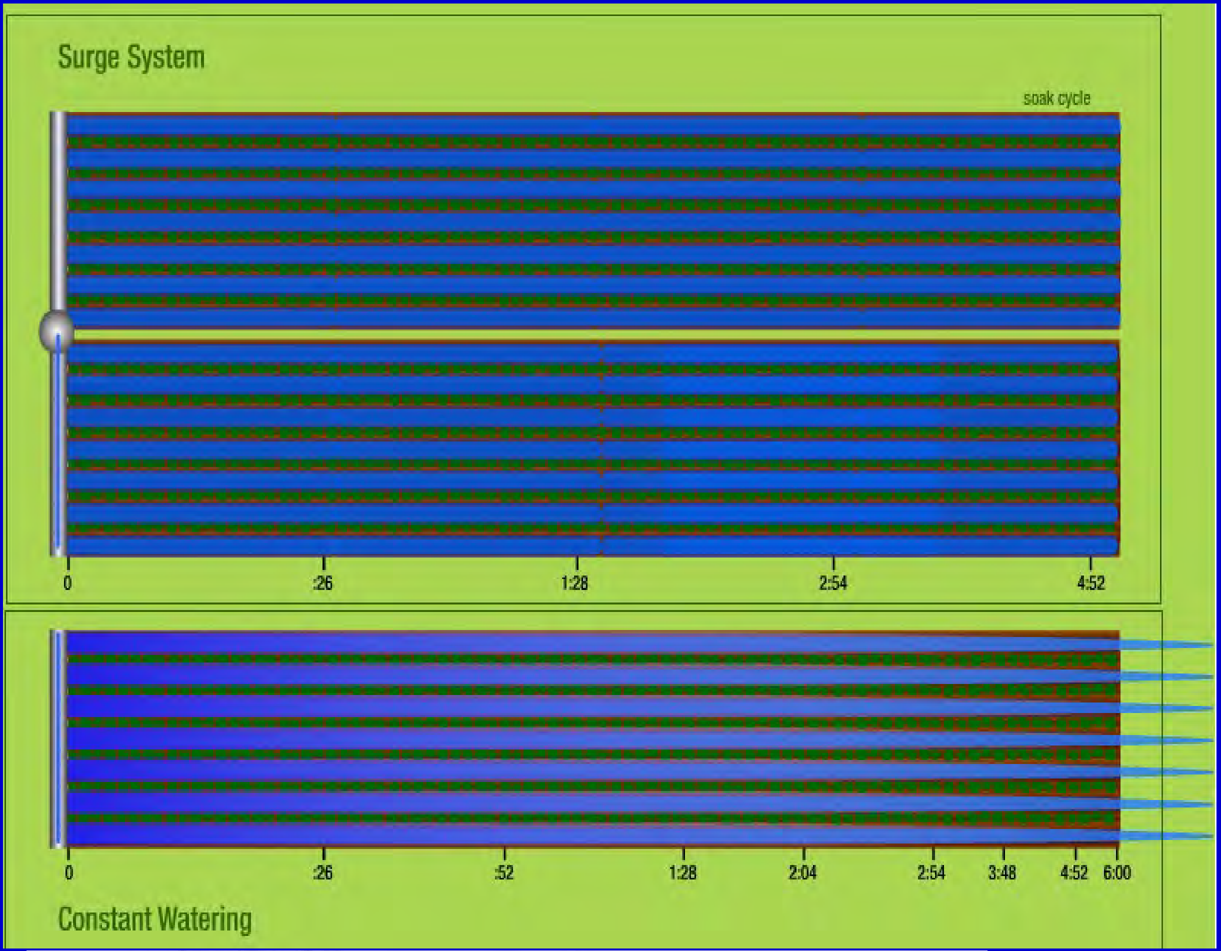
Surge: pulse 3 to field 1, pulse 2 to field 2 infiltrating.

Constant: water is advancing across entire field. Top of field has now had triple the irrigation time as the surge fields.



Surge: pulse 3 to field 1 completed, pulse 3 to field 2 on-going.

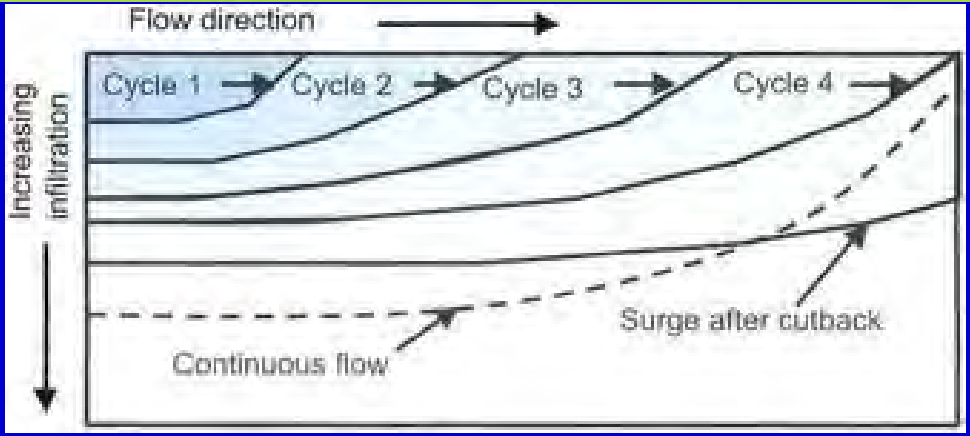
Constant: water is advancing across entire field. Top of field has now had triple the irrigation time as the surge fields.



Surge: pulse 5 to field 1 completed, pulse 5 to field 2 on-going.

Pulse 6 may be split to field 1 and 2 simultaneously for a final infiltration period with minimal tailwater.

Constant: water has advanced across entire field and has been in tailwater runoff to irrigate the bottom of the field. Top of field has now had 5 times the irrigation time as the surge fields.



Surge has uniform infiltration across field

Constant watering is uneven and has to have significant tailwater loss to irrigate bottom of field.

Center Pivot Irrigation and Components

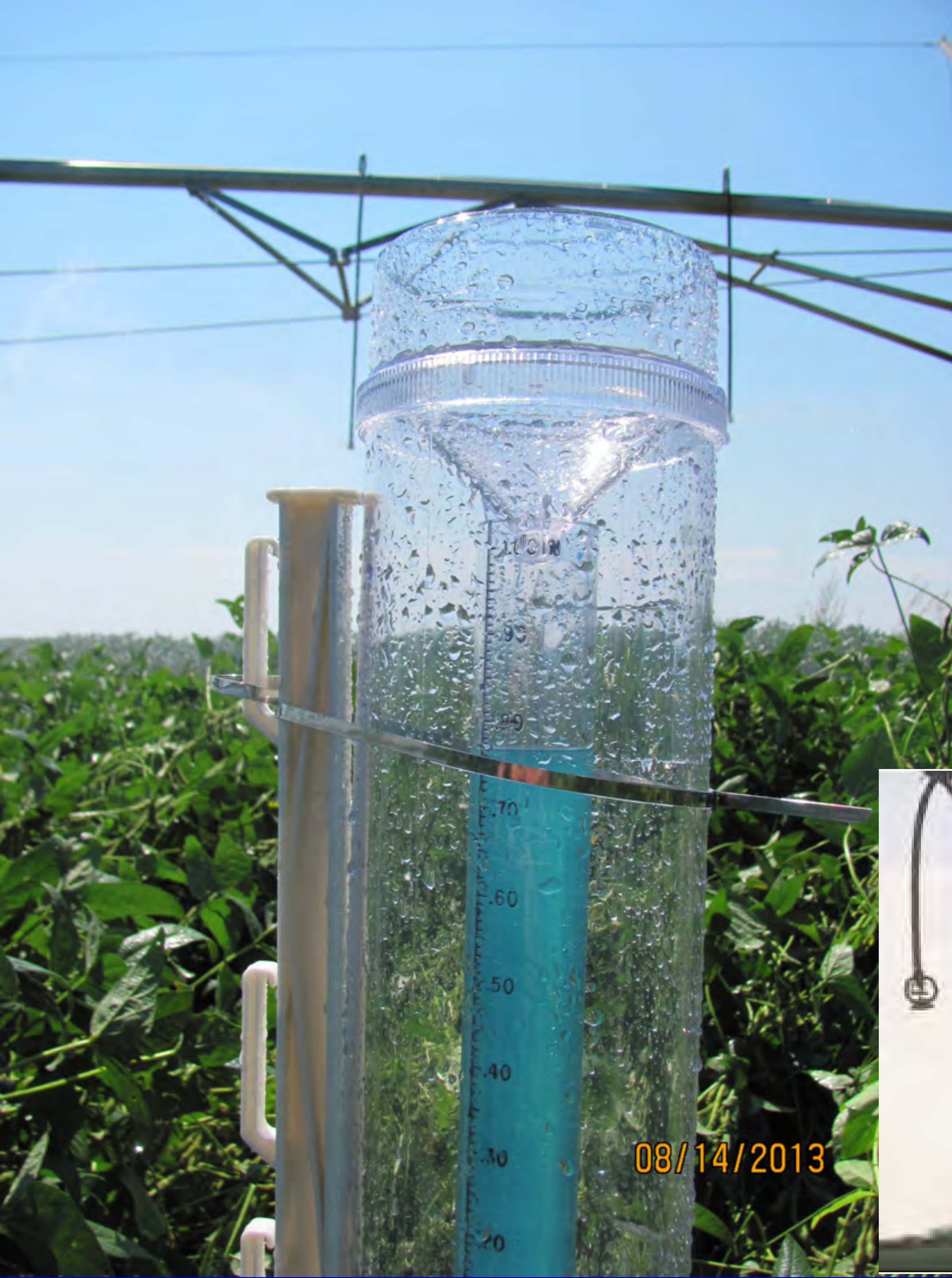
Water Source: surface, groundwater
- screening

Pump - flowmeter
Distribution - pivot, nozzles

Design depth (typically 1")
Speed : typically 4 days for a full rotation
Runoff: should be none
End-gun: to irrigate corners or increase irrigated areas

Increasing Efficiency

- Crop rotation/cover crops/residue management/reduced tillage
  (increase and maintain organic matter, increase infiltration rate and water holding capacity, increase rooting depth, greater rainfall capture)
- re-nozzle, drops (better distribution, lower energy, lower application rate)
  - drops alternate sides and are attached to outer truss
- Soil Moisture, irrigate based upon soil moisture and crop growth stage
- furrow diking (prevents water movement if application rate too high)



- measure application depth (in)
  annually (raingage)

- measure application rate (in/hr)
  (raingage, stopwatch)

- Most system should apply 1” to 1.2” in a 4 day rotation

- This system put out < 0.80”
  system constantly falling
  behind crop needs

Flood Irrigation and Components

Water Source: surface, groundwater

- screening

Pump - flowmeter

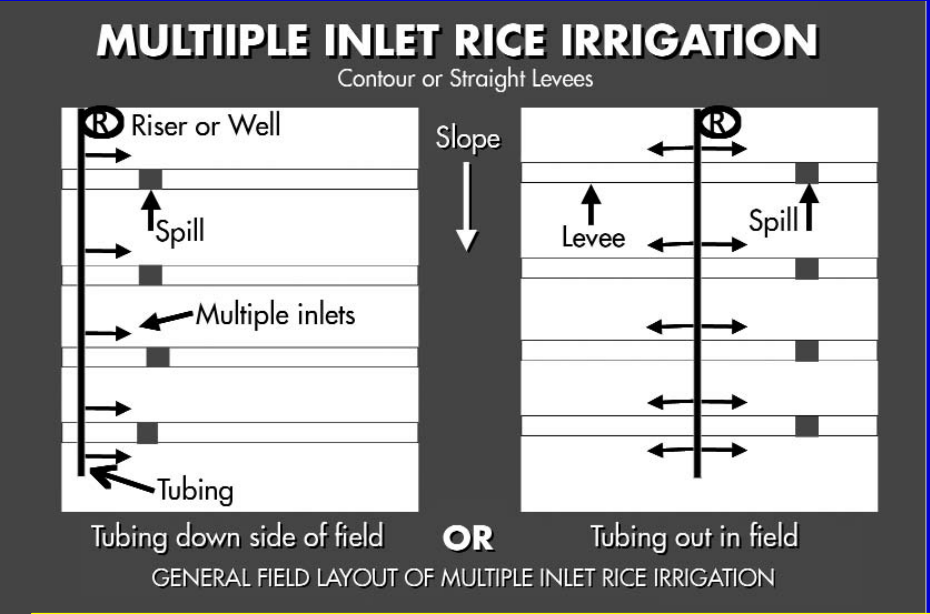
Underground line and riser with hydrant/direct connection

Distribution line - polypipe for multiple, side inlet

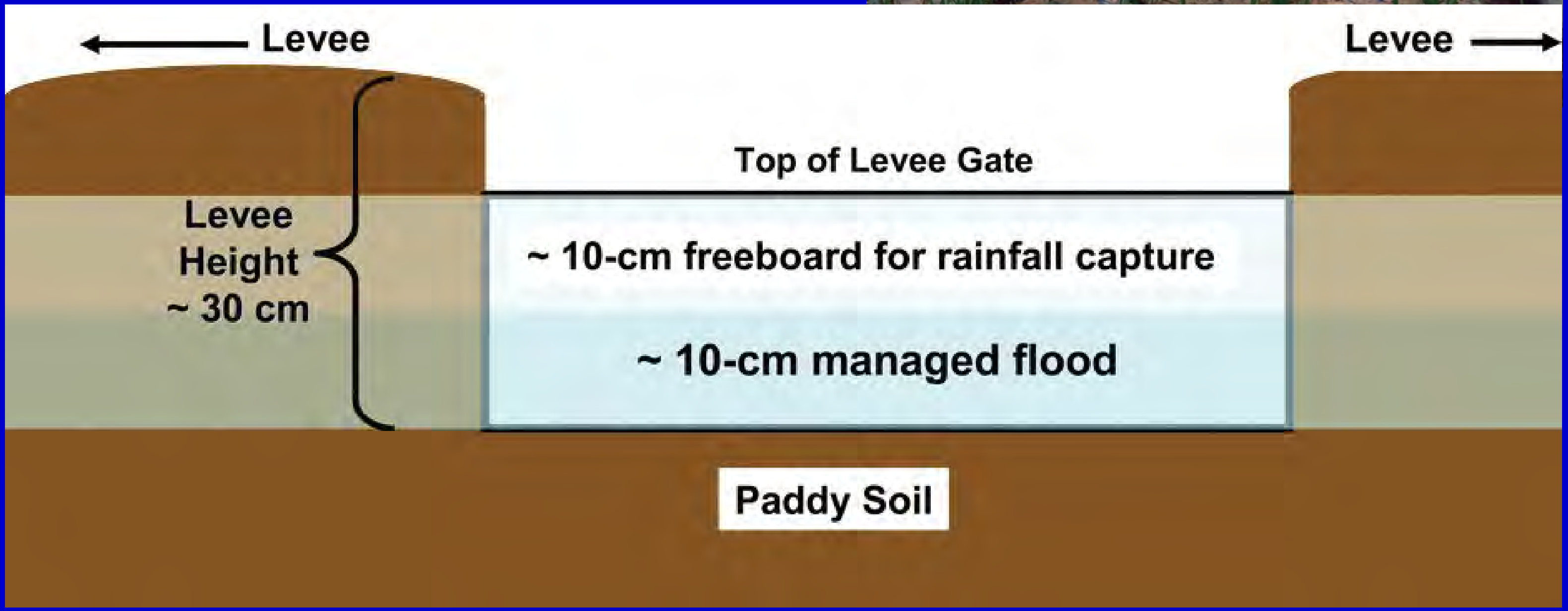
Flush time, Flood up time, Replenishment time (meter out water)

<u>Increasing Efficiency</u>

- Crop rotation/cover crops/residue management/reduced tillage
  (increase and maintain organic matter, increase infiltration rate and water holding capacity, increase rooting depth, greater rainfall capture)
- Timer/remote operation of well
- multiple/side-inlet (maximize rainfall capture, leave freeboard in rice cuts)
- Polypipe hole sizing (increases distribution uniformity of side-inlet system)
- Water Level Monitoring, irrigate to maximize rainfall capture
- EARLY DRYDOWN - plan water loss to dry field at crop end (no drainage)
- AWD (alternating wetting and drying) lower water table
    - a greenhouse gas reduction methodology, not a water conservation methodology



Multiple/side inlets to harvest rainfall. Irrigation into each cut directly, not flow through, allowing freeboard.



Aquaculture Irrigation and Components

Water Source: groundwater

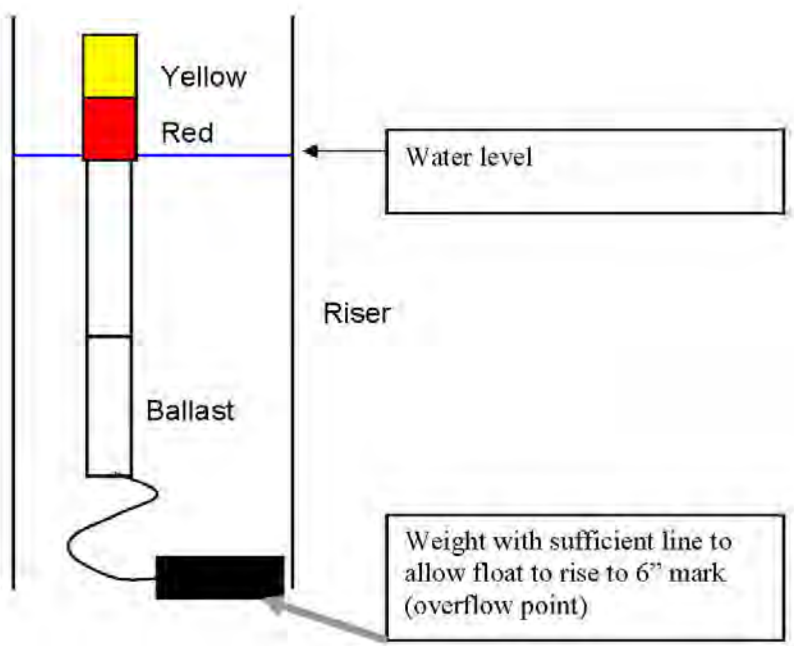
Pump - flowmeter
Underground line - direct discharge

Replenishment Rate - meter out

<u>Increasing Efficiency</u>

- 6/3 method (rainfall harvesting)
- Timer/remote operation of well
- Water level for 6/3 method
- Split-pond design: lower energy requirements, increase production/ac

Figure 1. Diagram of 6/3 Float in riser



Irrigation Water Management and Components

- Flowmeters

- Soil/water level sensors

- Irrigation Scheduling routines

- raingages/Weather stations

- Surge/automated risers

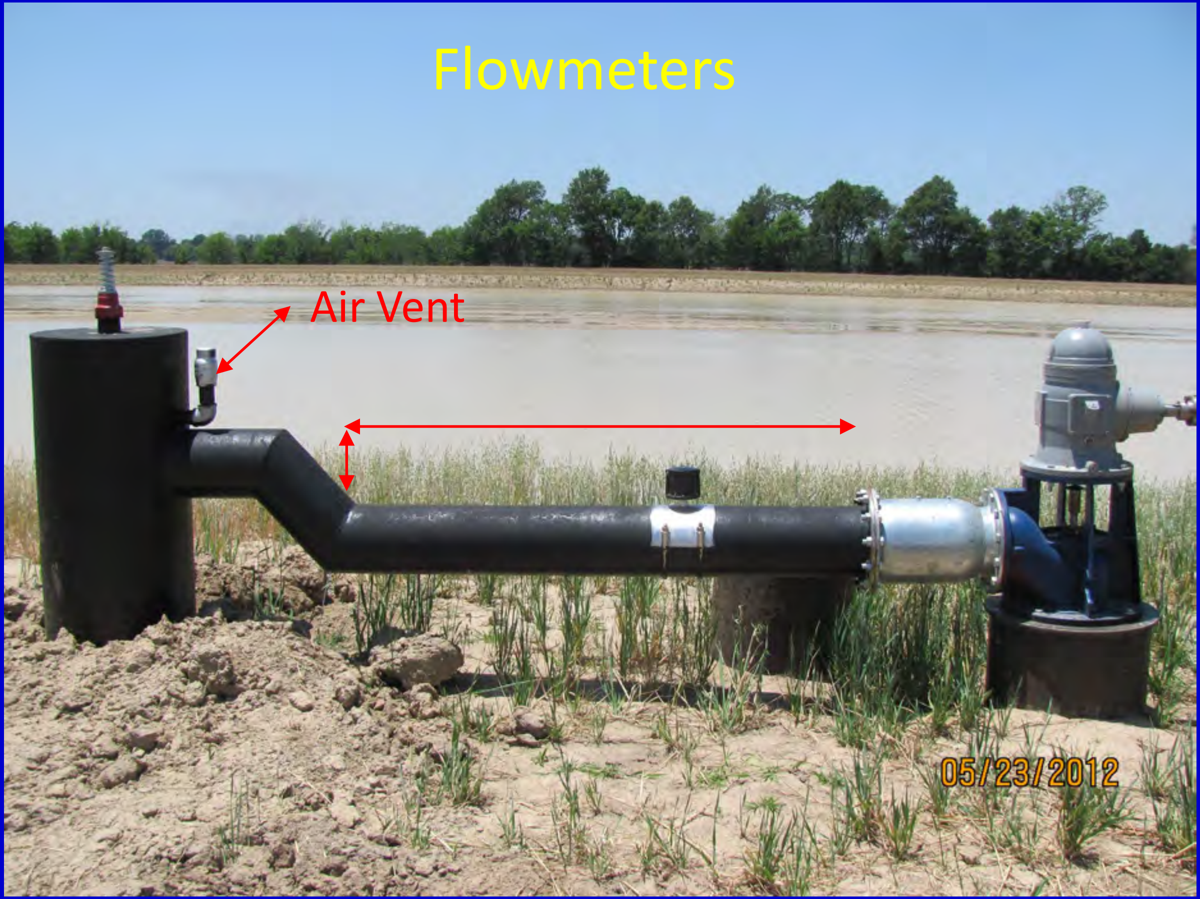
- IWM records by field

- Water level monitoring

- pumping plant evaluations (have to be practical, economical - high water costs)

- Telemetry: remote monitoring/control/record keeping of system

Flowmeters



To read correctly flowmeters need:

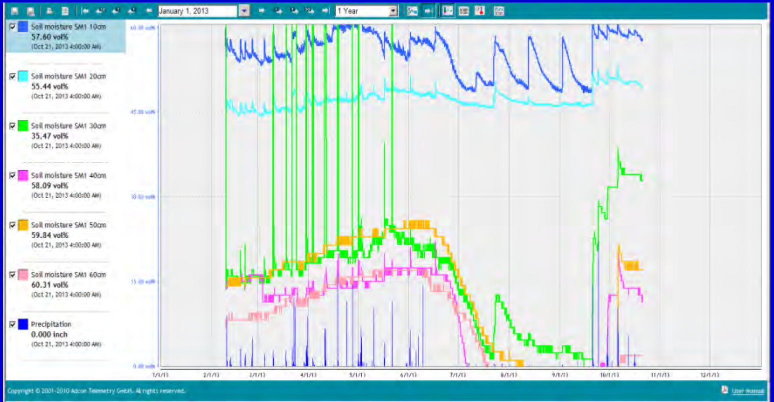
- Upstream and downstream straight distances to stabilize flow
- 1 diameter rise downstream to insure pipe flow

In field, check to see if air vent is closed, see condensation line on stand.

- measure flowrate, total applied: use to meter out water
- check long term pump/well performance (water table decline, pump degradation)
- ensure that flowmeter pipe section is full (don't assume), thus 1D rise in fixed pipes

Typical IWM Practices (Top of Field)

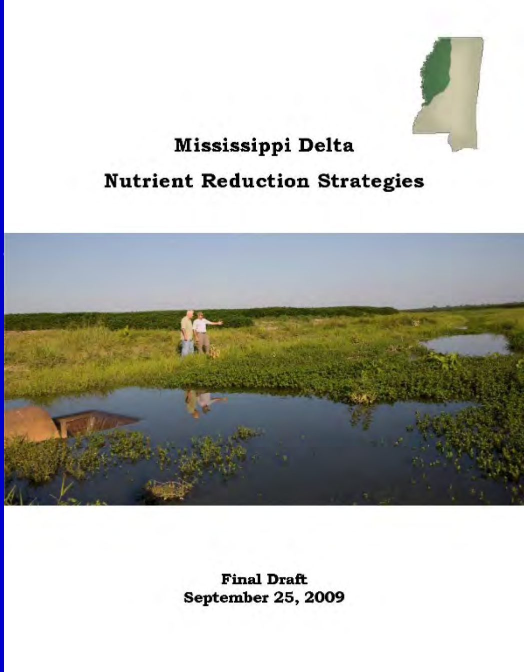
- Flow measurement (Flowmeter)
  - 587 Flowmeter (fixed or portable)
- Polypipe hole sizing (Phaucet, PipePlanner)
  - 449 - Intermediate Irrigation Water Management - Water Management Device (soil moisture sensor, atmometer)
  - 449 – Irrigation Water Management Device
  - Irrigation Scheduling Program (MIST, etc.)
  - 449 – Advanced irrigation Water Management
    (either Intermediate or Advanced, not both in same contract)
- Timer
  533 – Basic Pump Automation
- Surge valve
  443 – Irrigation System, Surface and Subsurface



Bottom of Field Conservation:

Alternative Water: On-Farm Storage/Tailwater Recovery

- On-Farm Storage:
  - goal: capture 50% of annual storm runoff and 100% of irrigation return flows
  - over 10 year period reduce groundwater demand by 80% on planned acreage
  - Benefits:
    - Nutrient reduction
    - reduce groundwater demands
- Tailwater Recovery:
  - goal: capture 100% of irrigation return flow from designated fields
  - Benefits:
    - Nutrient reduction
    - reduce groundwater demands -25%



(I use SPAW to evaluate designs)

TWR: 12 ac-f t of storage per 40 acres (= 3.6 inches of irrigation water for a 40)

YMD

On-farm Storage reservoir: 1 acre for each 16 acres to be irrigated (10 acres per 160 acres
- will replace over 80% of groundwater use, at a much lower pumping cost
- over 25 years will pay for itself w/o F/A, including loss production on 10 acres

Surface water utilization: reduce groundwater use, reduced pumping costs

- surface water availability is very variable
- construct weirs to increase water availabilty

Soil Health

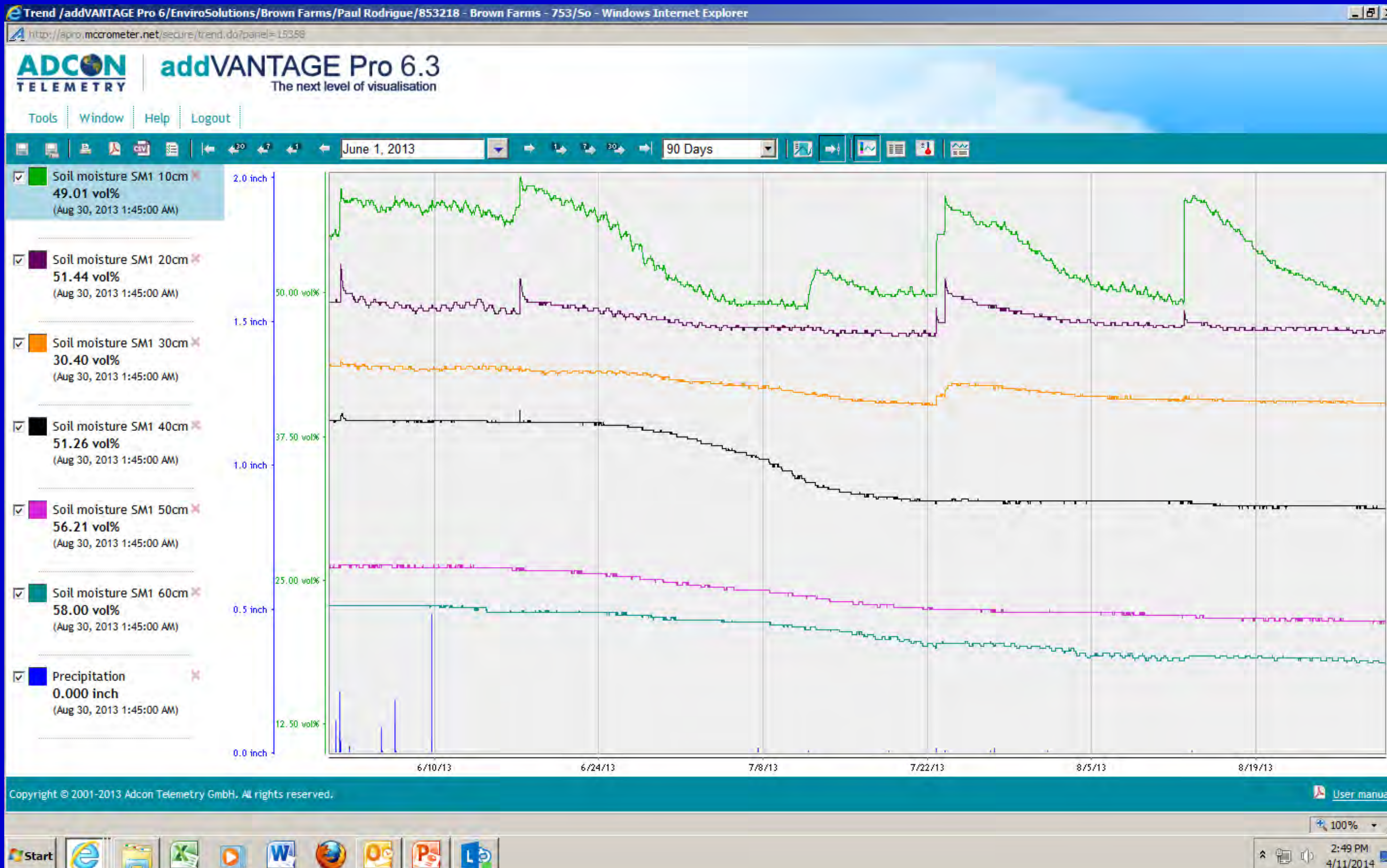
- **Managing for Soil Health is one of the easiest and most effective ways for farmers to increase crop productivity and profitability while improving the environment.**

- **Soil Health is critical to Irrigation Water Management and esp. Dryland Farming:**
  - rooting depth (access to water, nutrients)
  - soil water holding capacity (soil structure, organic matter)
  - infiltration capacity (soil structure, organic matter, absence of restrictive/compacted layer)

- Four basic principles is the key to improving the Health of your Soil.

1. Keep the soil covered as much as possible
(residue management/cover crops/stale seedbed/winter "weeds")
2. Disturb the soil as little as possible
(limit disking/cultivation/control traffic patterns)
3. Keep plants growing throughout the year to feed the soil
(cover crops/winter "weeds")
4. Diversify as much as possible using crop rotation and cover crops
(keep a crop rotation going, helps with resistant weeds too)

Soil Moisture Sensors



- tension/volumetric/dielectric (everything requires some calibration)
- 3 sensors, depths and locations
- trigger point (MSSTATE says 75 cb with tension type)
- *sharp spikes at rainfall/irrigation events at depths >6" indicates preferential flow (leak)*
- ***<u>the better the soil health, the more beneficial and easier soil moisture sensors are</u>***

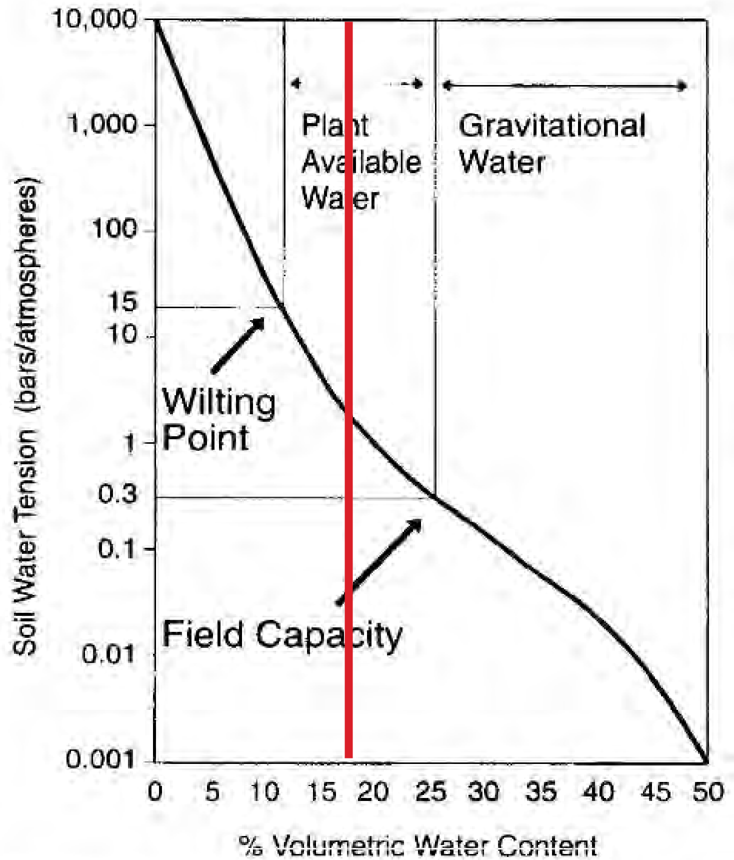
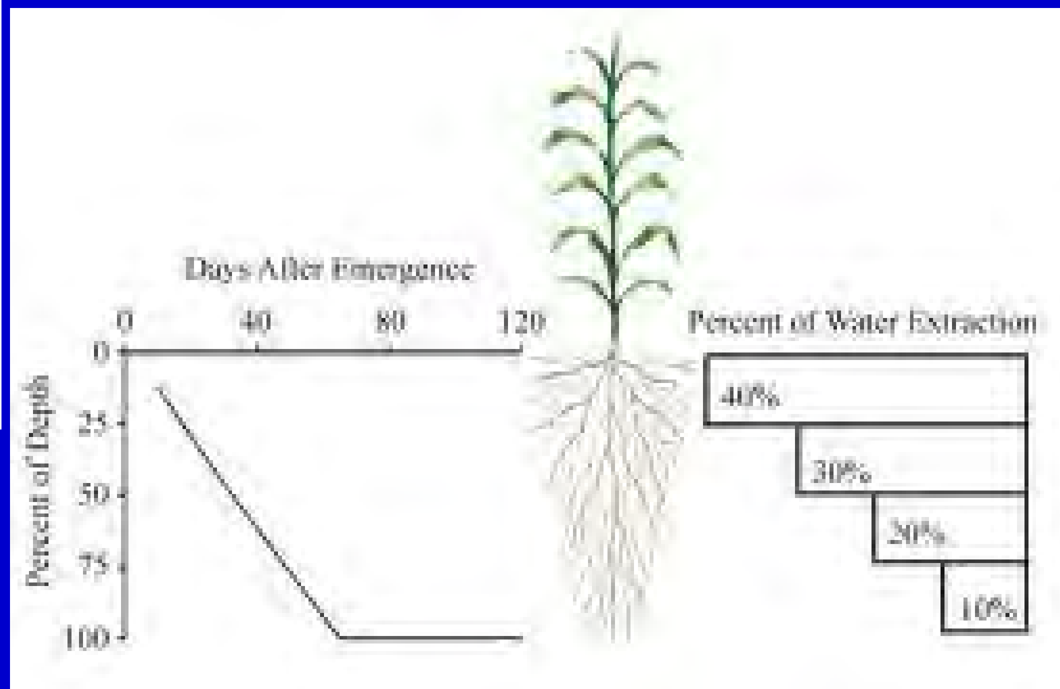


Figure 6. *The relationship between soil water content and soil water tension for a loam and type.*

In Figure 6, at left, field capacity is at approximately 25% volumetric water content, and wilting point is at approximately 12% volumetric water content. Therefore our 50% plant available water (PAW) would be at approximately 18% volumetric water content. Note, this is based on the soil water characteristic curve, not the beginning and ending numbers, there is not a straight line relationship.

PAW varies with growing season, rooting depth.



Pump Support Design

Farm Plan for :	0	Farm #:	0
System # :	0	Tract # :	0
Designed By :	pbr	Date :	May 19, 2014

Alternative Designs include:
- camel back pumps w/ramps
- floating pumps/intakes
- pumps suspended over water supply (e.g catwalks)
- pumps on slope of streambank
- other w/approval of NRCS office

Check ALL Green Box Value	
Input Data	
Structure # :	1
Select Type of Intake (See Drawing) :	Intake on Left
Pump Capacity (GPM) :	1800
Max. Intake Velocity (fps) :	2.0
A--Top of riser pipe to bottom of intake pipe (ft) -min based on design, alter for site specific conditions:	10 Do not include stinger

Assume 3:1 bank slope

Intake on Left		
Pipe Size (in)	21	Min
B-Intake Length (Ft)	36	Min
Pipe Material	Steel	
Velocity (Ft/Sec)	1.7	
2 ft Sump	Yes	
Recommended Pipe Dia (in)	19.1	

Riser Pipe		
Riser Pipe Size (in)	21	Min
Riser Pipe Length (Ft)	13	Min
Riser Pipe Material	Steel	
Velocity (Ft/Sec)	1.7	
Screen area required	2. sqft	

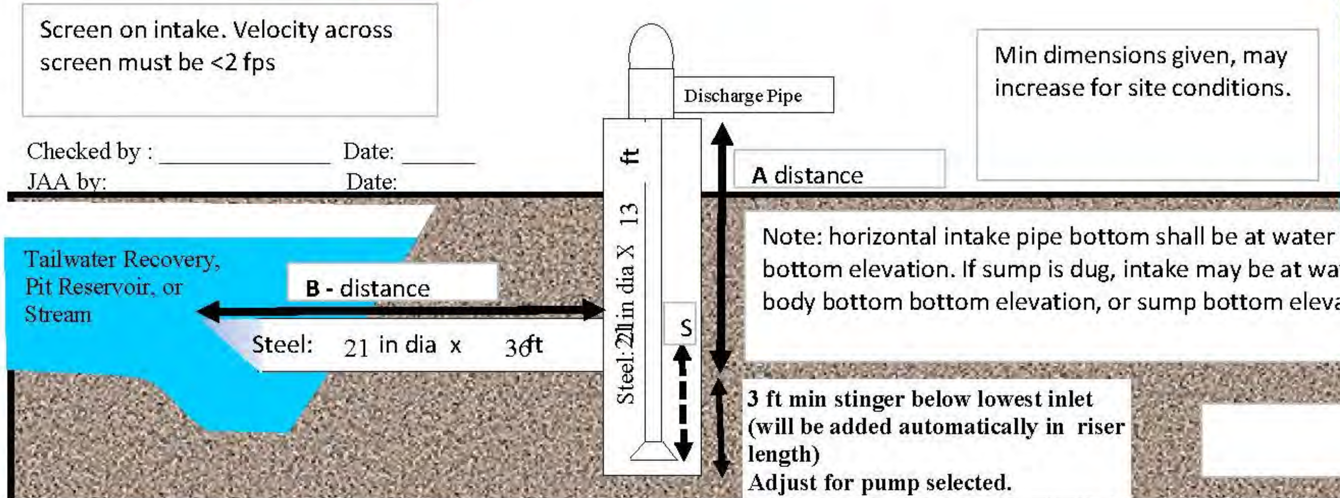
D (in) - pump intake	9.25	9.25
q (gpm)	1800	2800
S (in) above pump inta	57	84
V (fps)	8.6	13.4
Current S (in)	46.5	
Increase stinger to	4.0 ft	

Screen on intake. Velocity across screen must be <2 fps

Min dimensions given, may increase for site conditions.

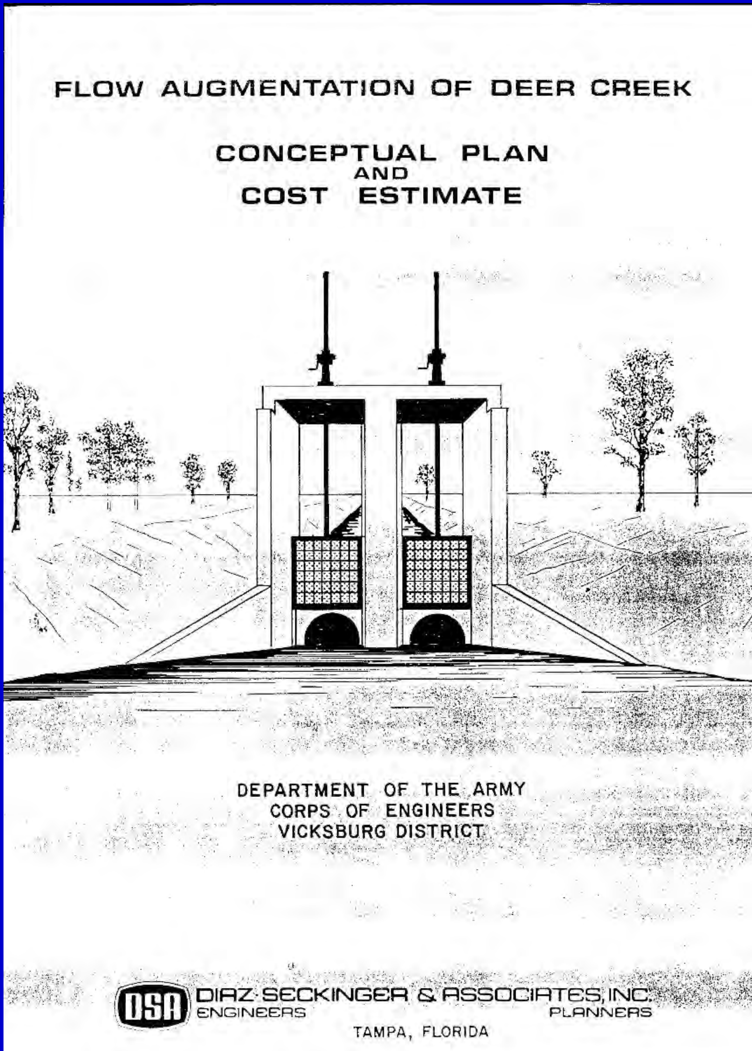
Checked by : _______________ Date: ______

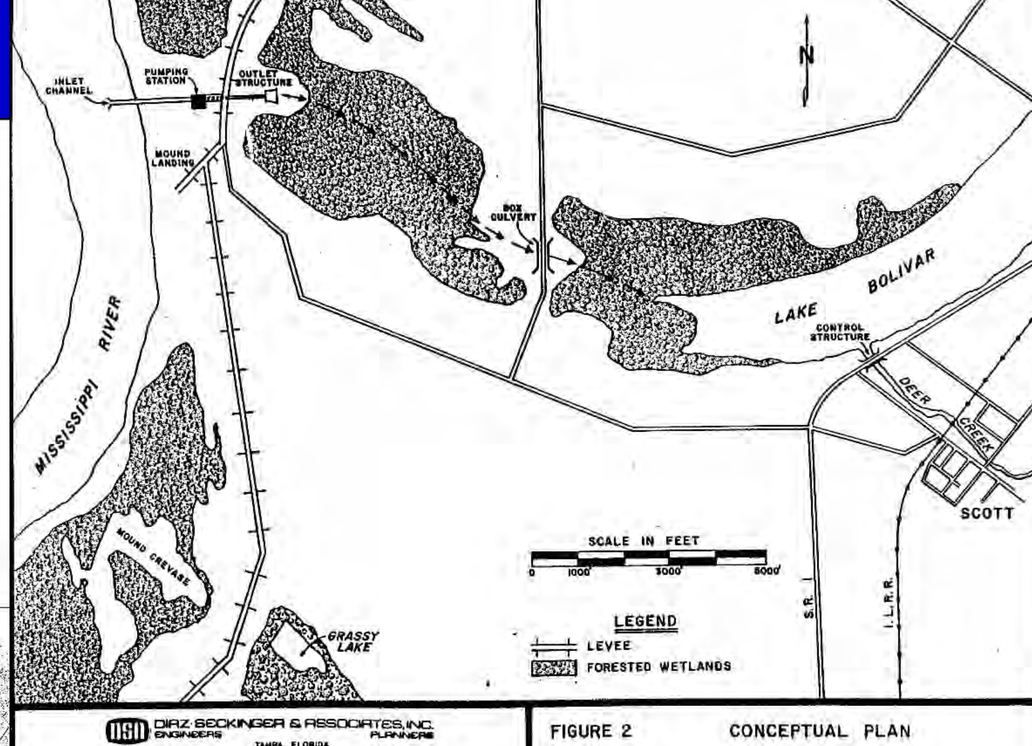
JAA by: Date:

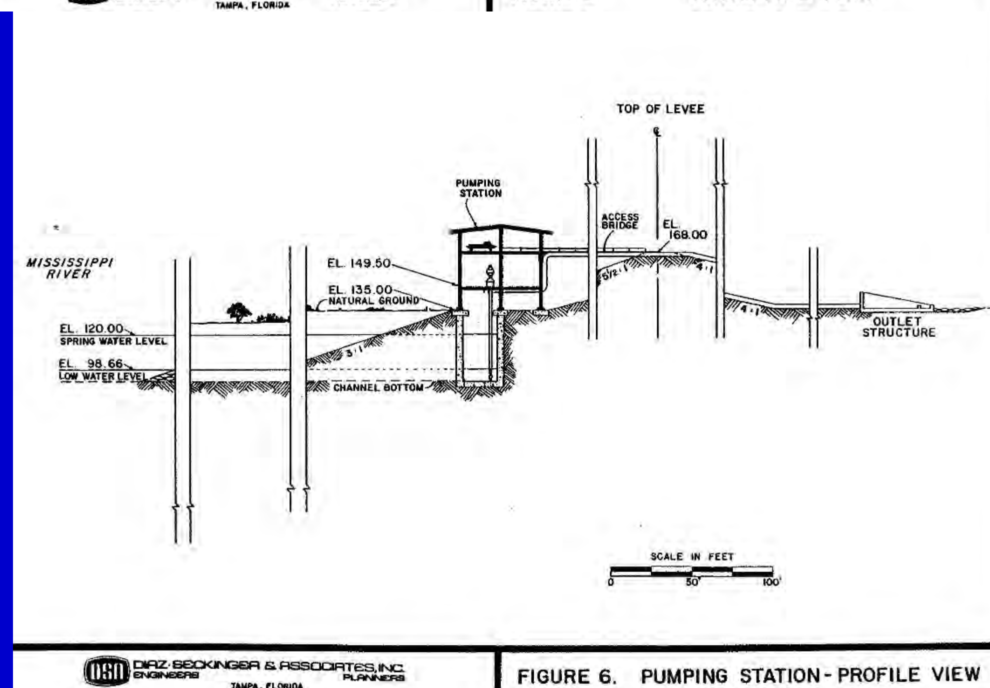


Concrete pads, gravel ramps for camelbacks, floating, etc. 430 will be installed at this point(s).

History of Delta Importation Plans







1979 - $6.6M for 750 cfs

								25 year			
System	Applied Before	Applied After	Total GW Before	Total GW After	Annual Pumping Costs	GW Water Savings	Cost per ac-ft saved	Present Cost	Present Cost per ac-ft saved	w F/A Present Cost	W F/A Present Cost per ac-ft saved
	(in/ac)	(in/ac)	(ac-ft)	(ac-ft)	($)	(ac-ft)	($/ac-ft/yr)	$	$/ac-ft	$	$/ac-ft
No IWM	14	14	187	187	$4,066	0	N/A	$56,924.00	N/A	$56,924.00	N/A
MWCMP - IWM	14	10.5	187	140	$3,049	47	$35	$85,949.18	$1,841.77	$44,980.26	$963.86
TWR	14	14	187	138	$2,545	49	$60	$125,213.80	$2,555.38	$51,543.80	$1,051.91
OFS	14	14	187	42	$1,331	145	$53	$275,673.86	$1,905.58	$84,586.26	$584.70
IRF	14	14	187	152	$2,913	35	$19	$59,463.41	$1,698.95	$43,076.21	$1,230.75
Surf to CP	14	8	187	107	$4,971	80	$38	$155,367.60	$1,942.10	$80,127.60	$1,001.60

FY17: Costs/impacts of various conservation measures.

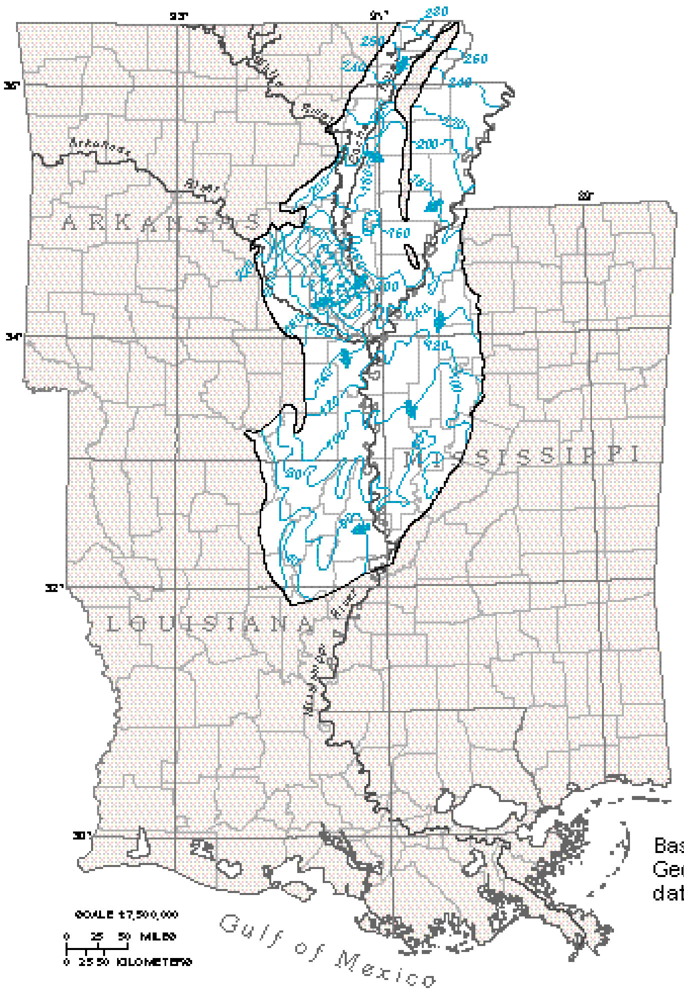


Figure 35. Although development of the Mississippi River Valley alluvial aquifer has been extensive, regional flow is south-ward and parallel to predevelopment regional flow, and many areas show only minor lowering of water levels. Large withdrawals from wells in the Grand Prairie (Arkansas, Monroe, and Prairie Counties) and the Cache River areas of Arkansas have lowered water levels considerably.

EXPLANATION

Grand Prairie area

120 **Potentiometric contour**—Shows altitude at which water would have stood in tightly cased wells from 1980 to 1990. Hachures indicate depressions. Contour interval 20 feet. Datum is sea level

Direction of ground-water movement

Base modified from U.S. Geological Survey digital data, 1:2,000,000, 1972

Aquifer Decline in Alluvial Aquifer of the LMRV

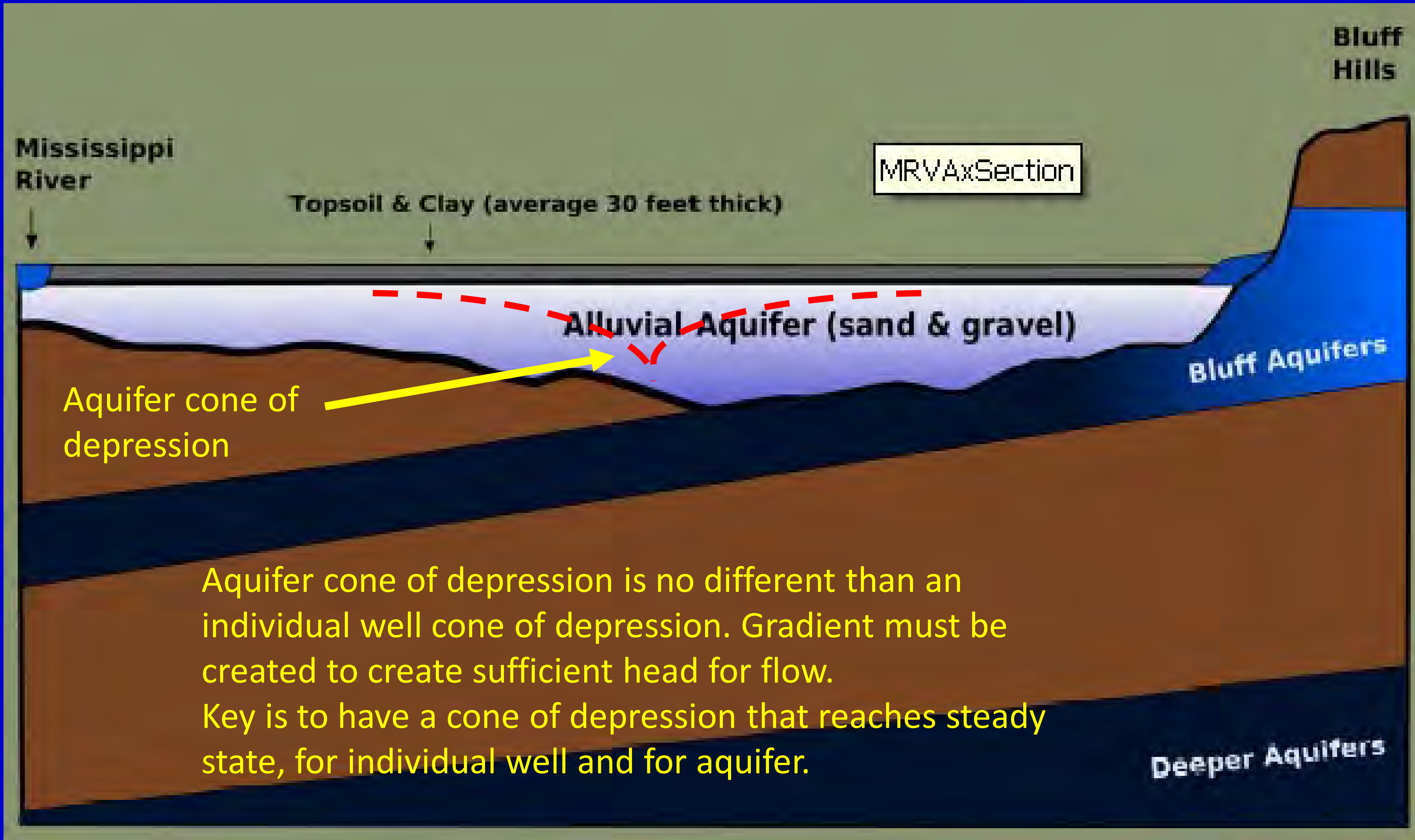
- must balance water withdrawals with recharge

- conservation
- importation

- AR has worst declines in Grand Prairie, Cache River areas

SW Louisiana has some saltwater intrusion

Modified from:
Wasson, B.E., 1980, Water-level map of the Mississippi delta alluvium in northwestern Mississippi, September 1980: Mississippi Department of Natural Resources, Water Resources Map 80–1, scale 1:500,000, 1 sheet.
Ackerman, D.J., 1989a, Hydrogeology of the Mississippi River Valley alluvial aquifer, south-central United States—A preliminary assessment of the regional flow system: U.S. Geological Survey Water-Resources Investigations Report 88–4028, 74 p
Ackerman, D.J., 1989b, Potentiometric surfaces of the Mississippi River Valley alluvial aquifer in eastern Arkansas, spring 1972 and 1980: U.S. Geological Survey Water-Resources Investigations Report 88–4075, scale 1:500,000, 1 sheet.
Seanor, R.C., and Smoot, C.W., 1995, Louisiana ground-water map number 6: Potentiometric surface, (1990), and water level changes, 1974–90, of the Mississippi River alluvial aquifer in northeastern Louisiana: U.S. Geological Survey Water-Resources Investigations Report 95–4146, scale 1:7,920, 2 sheets.



Aquifer cone of depression is no different than an individual well cone of depression. Gradient must be created to create sufficient head for flow.

Key is to have a cone of depression that reaches steady state, for individual well and for aquifer.

Alluvial Aquifer is recharged to west by MS River, to east by Bluff Hills, limited areal recharge, limited recharge by internal rivers/streams.

So cone of depression for aquifer develops at the midpoint (e.g. Quiver River area)

QUESTIONS

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Natural Resources Conservation Service