Irrigation Water Management and Scheduling

Presented by:
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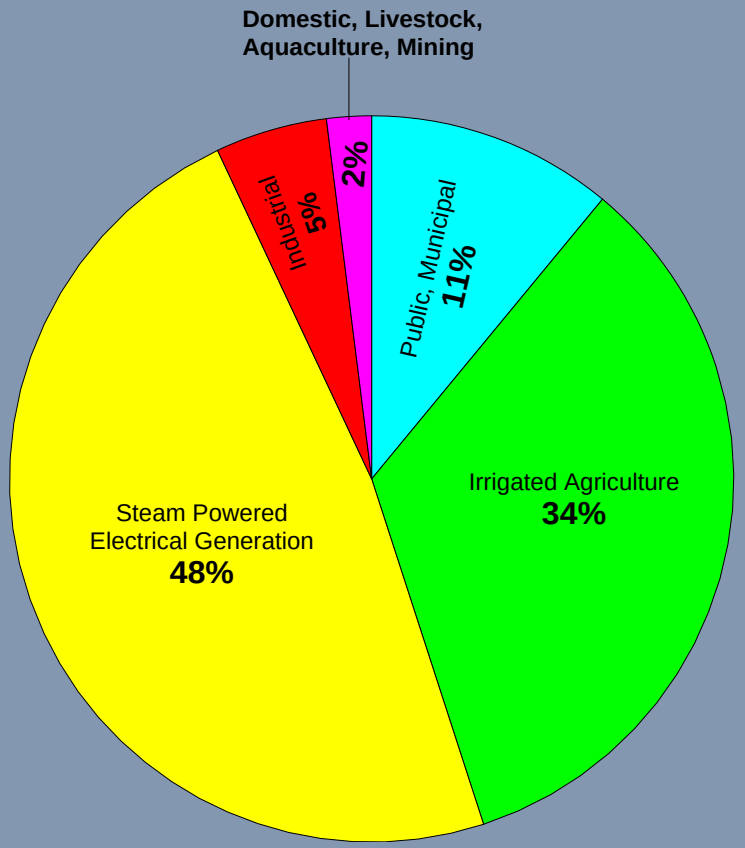
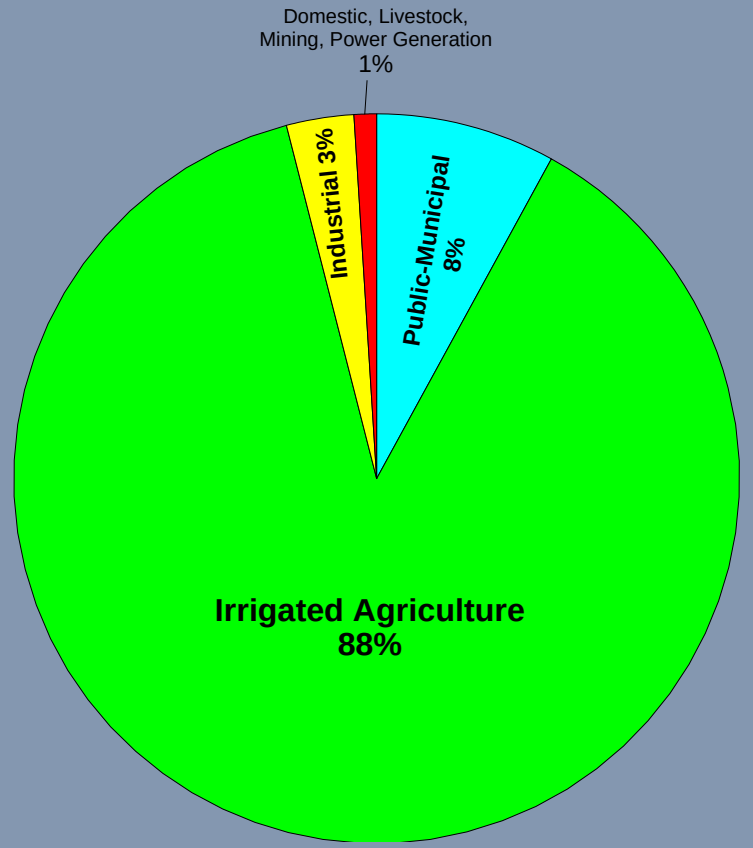


USA Fresh Water Use



Oregon Fresh Water Use

Water Use

Why Is Irrigation Water Management (IWM) Important? ??

- ✓ Improve irrigation water efficiency
- ✓ Minimize soil erosion
- ✓ Decrease runoff and leaching of nutrients
- ✓ Improves water quality
- ✓ Improves aquatic Habitat
- ✓ Reduces energy consumption
- ✓ Improves soil quality and plant health
- ✓ Improves yields

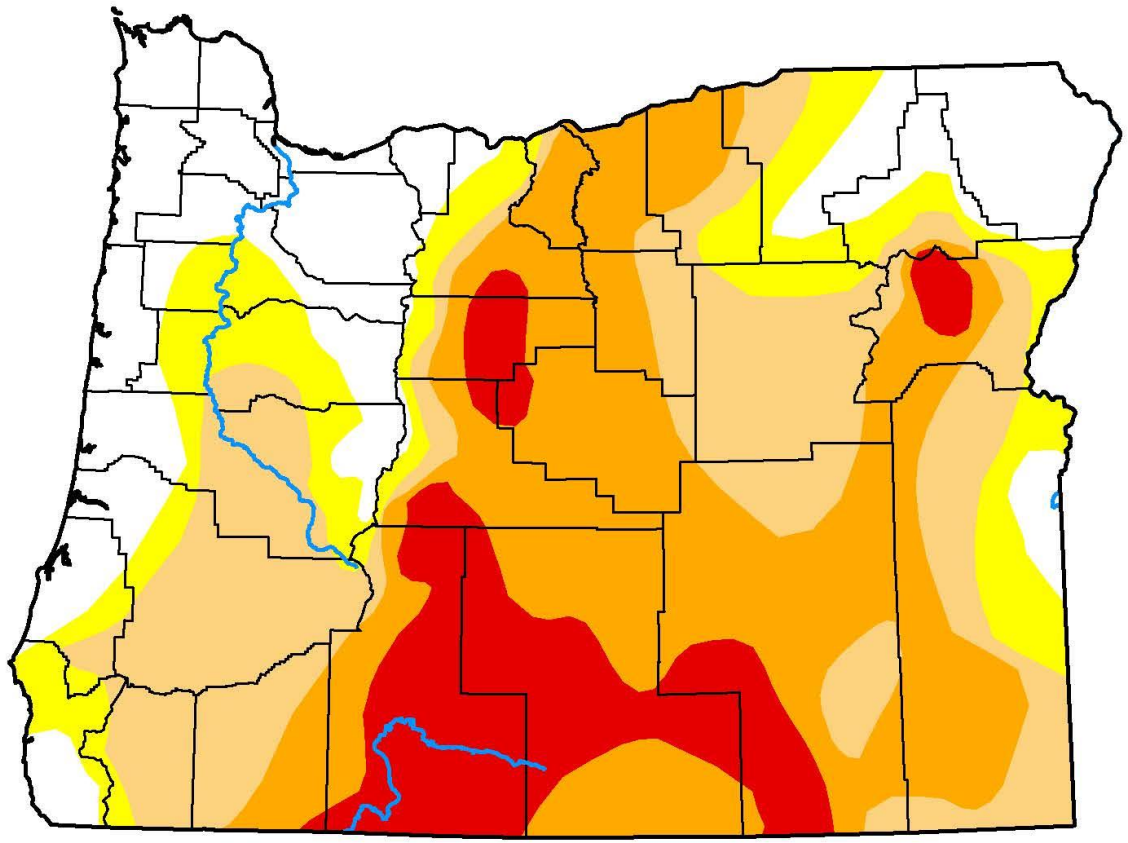
U.S. Drought Monitor

Oregon

March 30, 2021

(Released Thursday, Apr. 1, 2021)

Valid 8 a.m. EDT



Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

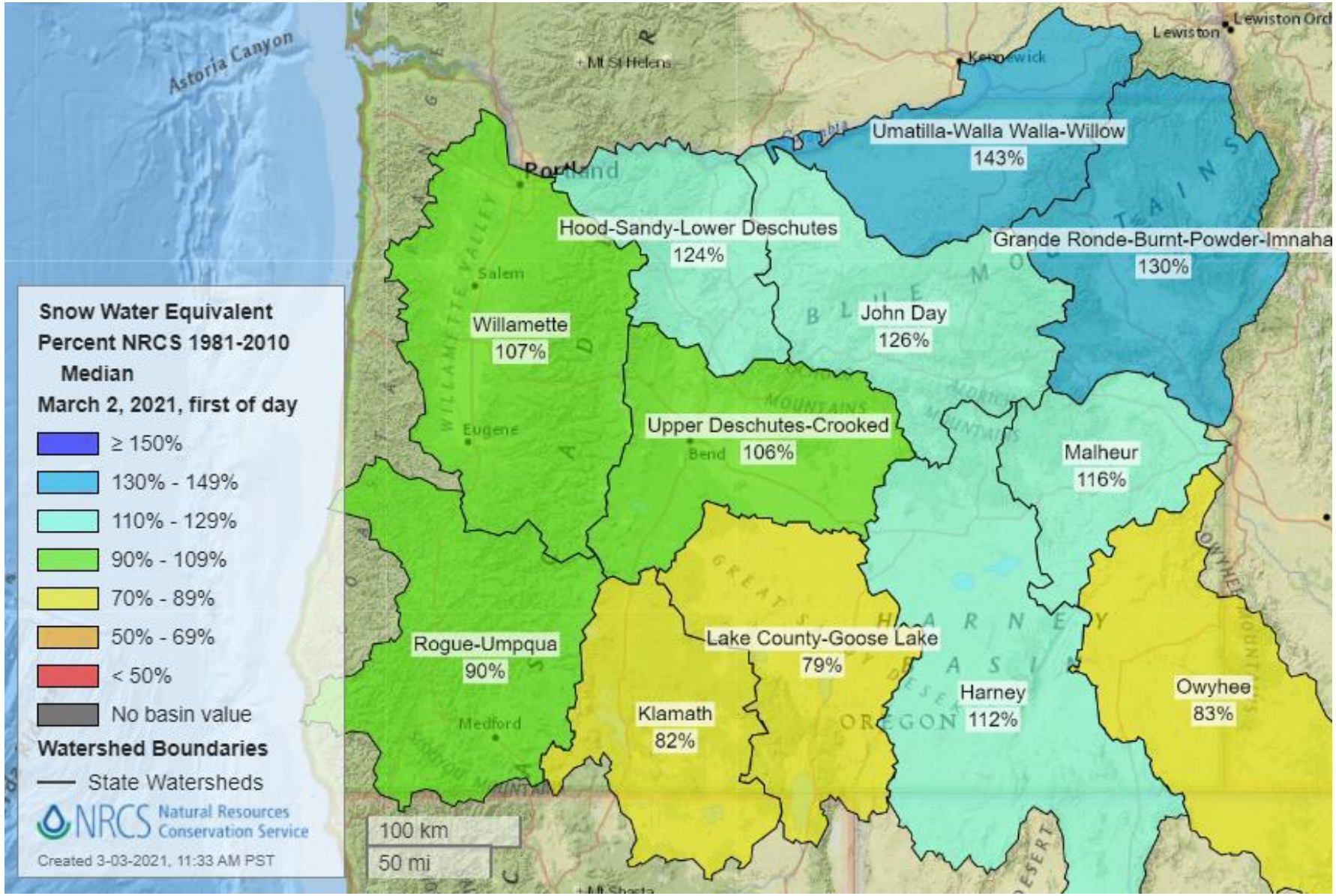
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

Author:

Brad Pugh
CPC/NOAA

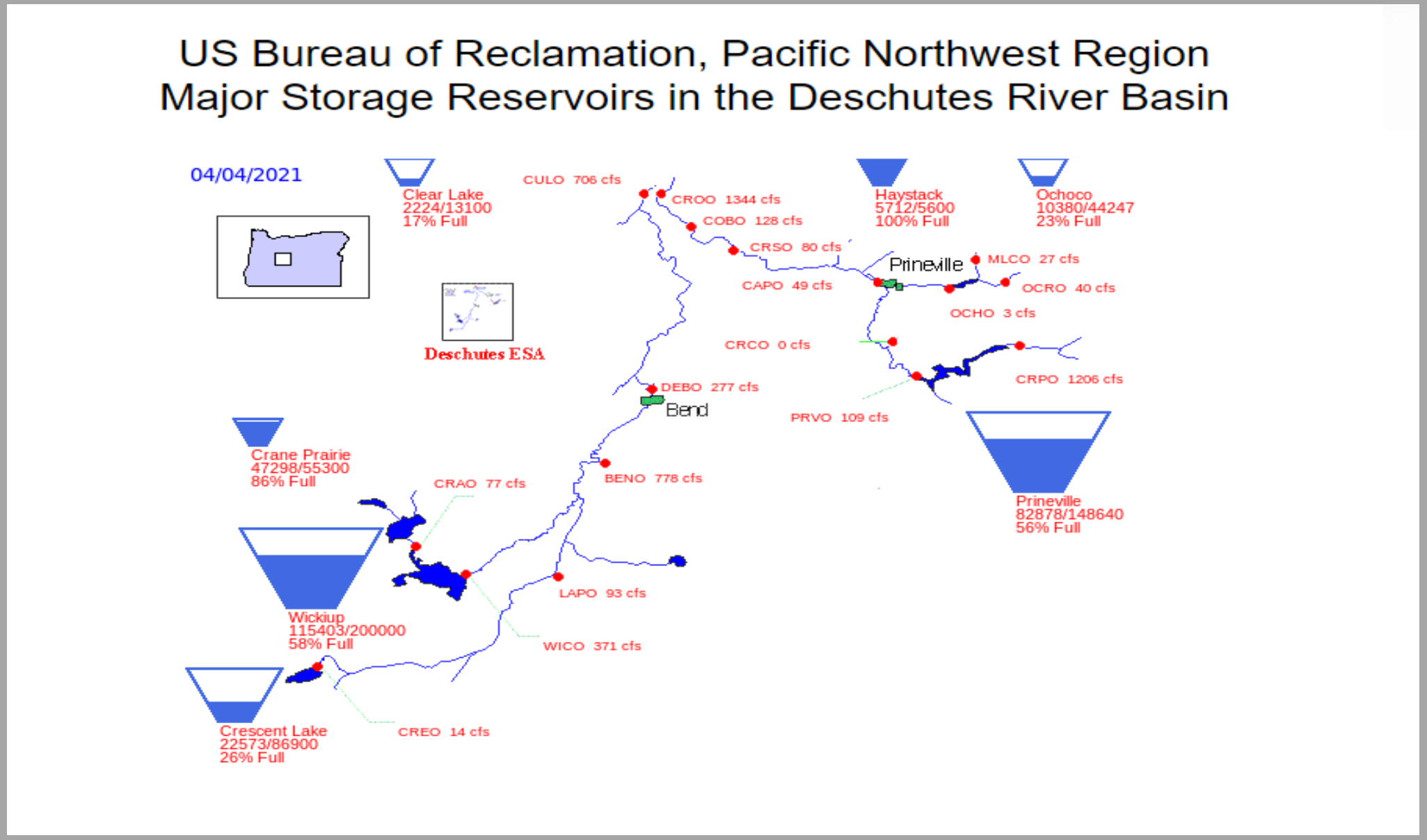
droughtmonitor.unl.edu

So where does our water come?

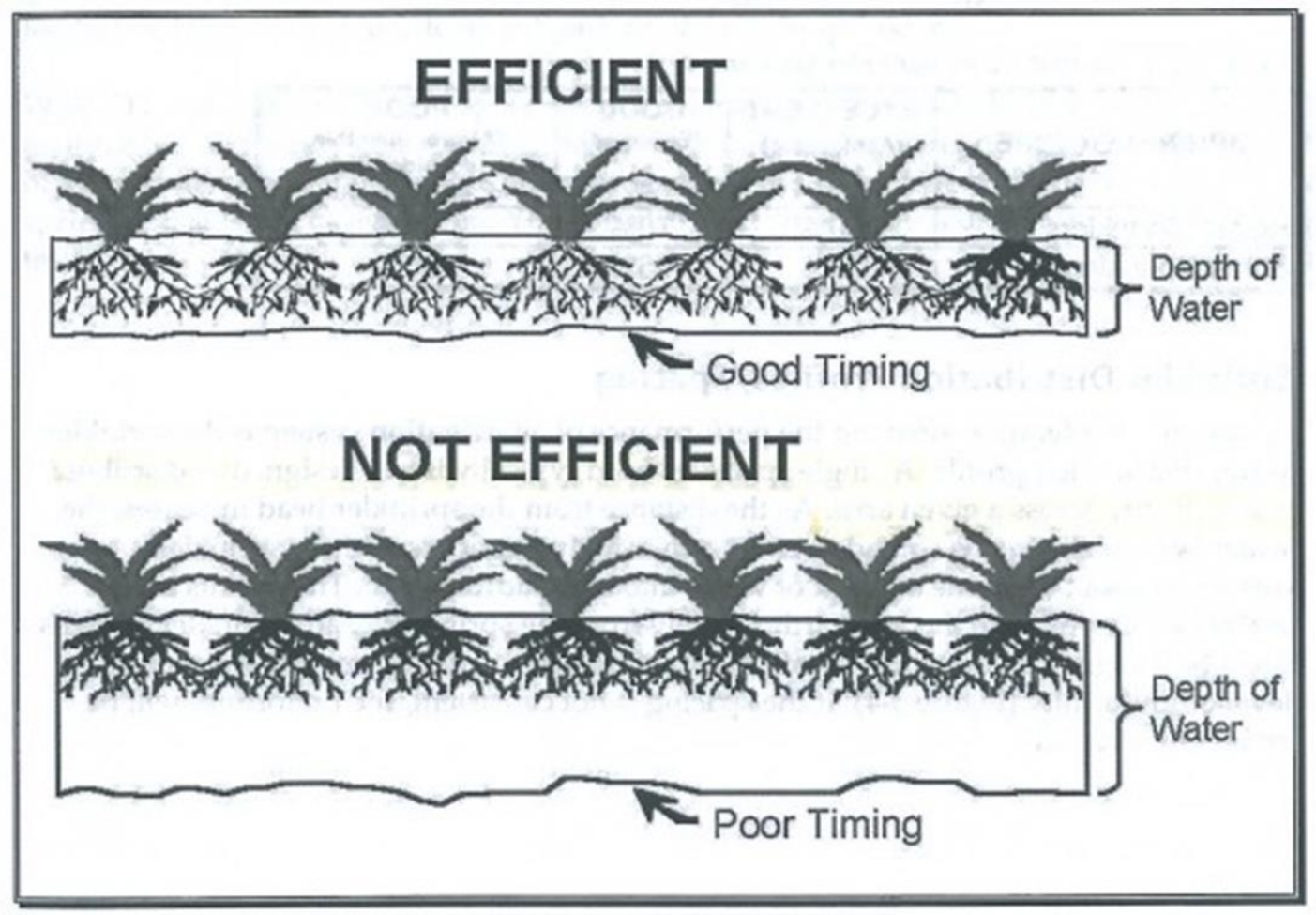


US Bureau of Reclamation, Pacific Northwest Region Major Storage Reservoirs in the Deschutes River Basin

[Hydromet Pacific Northwest Region | Bureau of Reclamation (usbr.gov)]

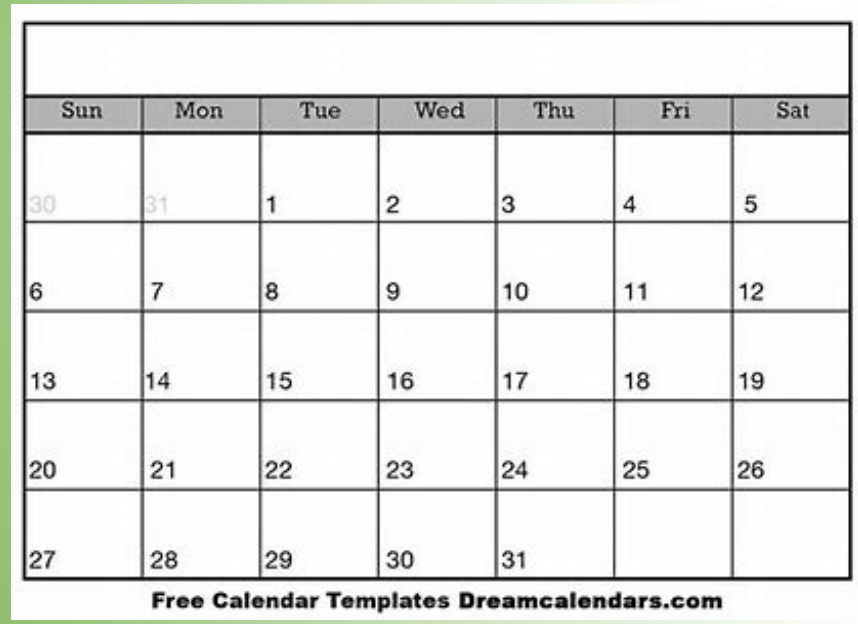


Irrigation Water Management (IWM) applies water **when** and **where** it is needed



What is Irrigation Water Management (IWM) ?

Its as easy as 1, 2, 3!

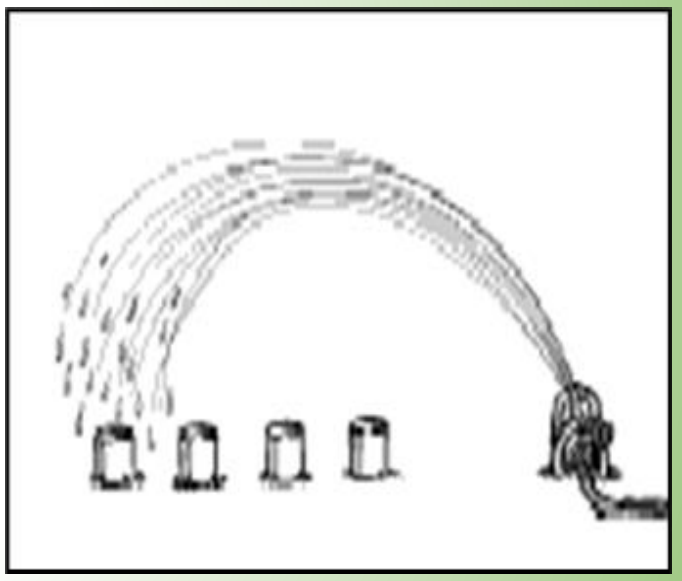


Sun	Mon	Tue	Wed	Thu	Fri	Sat
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

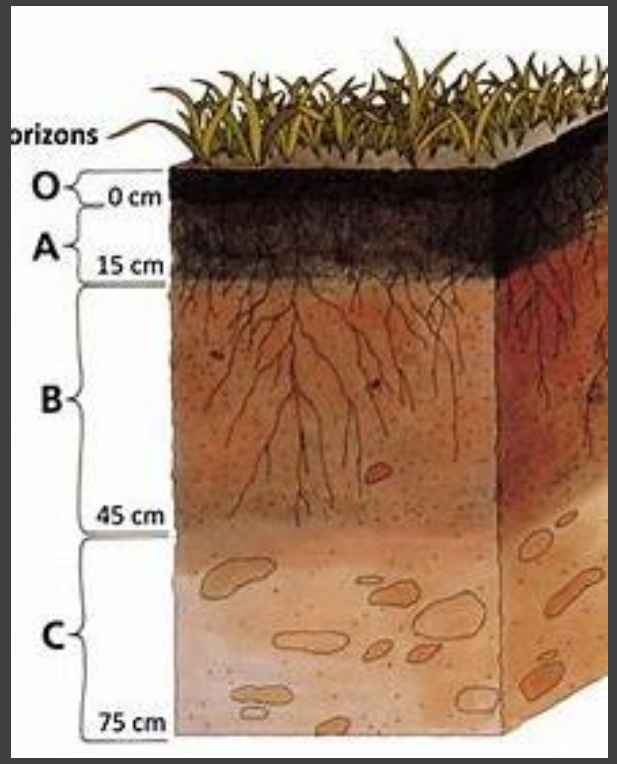
Free Calendar Templates Dreamcalendars.com

When to apply
(irrigation Interval)

How much to apply
(Set Time)



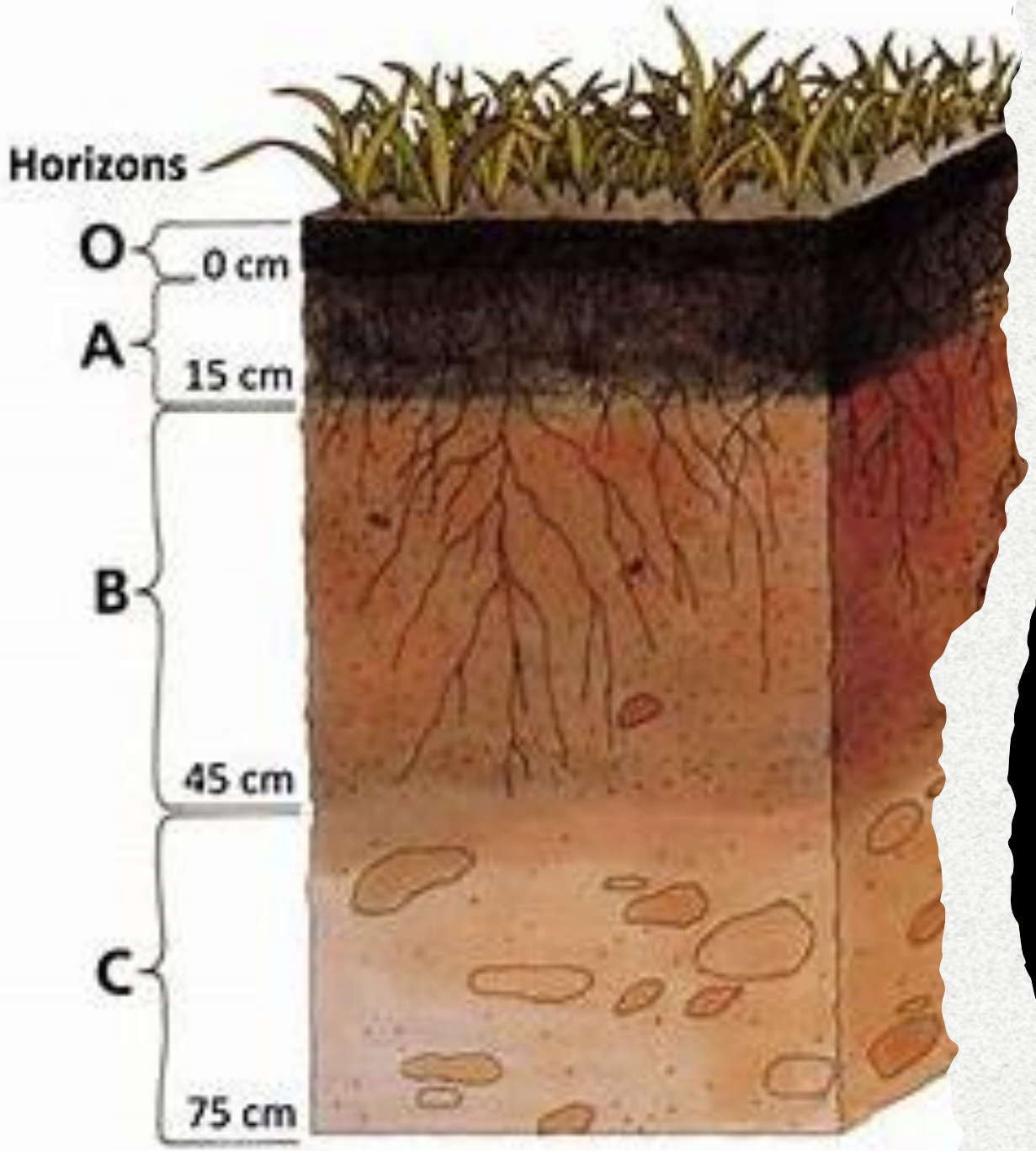
What rate to apply
(Nozzle size, type and design)



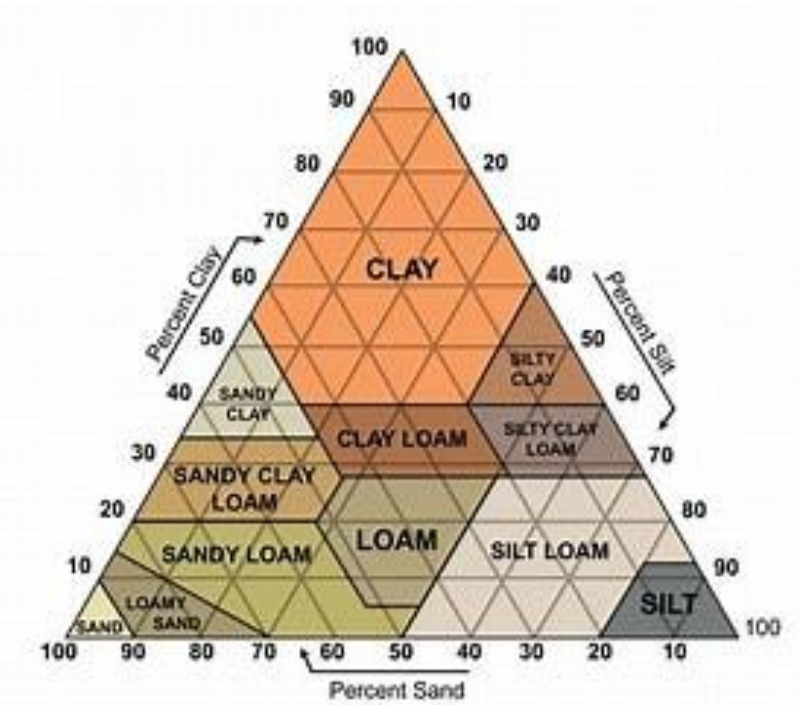
How Do I Become a Better Irrigator?

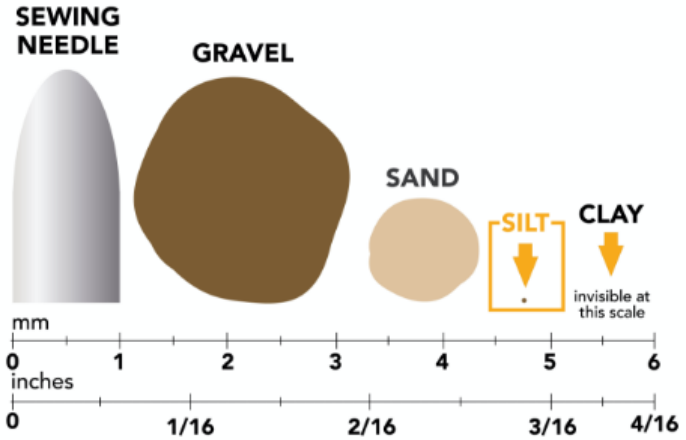
Elements of IWM:

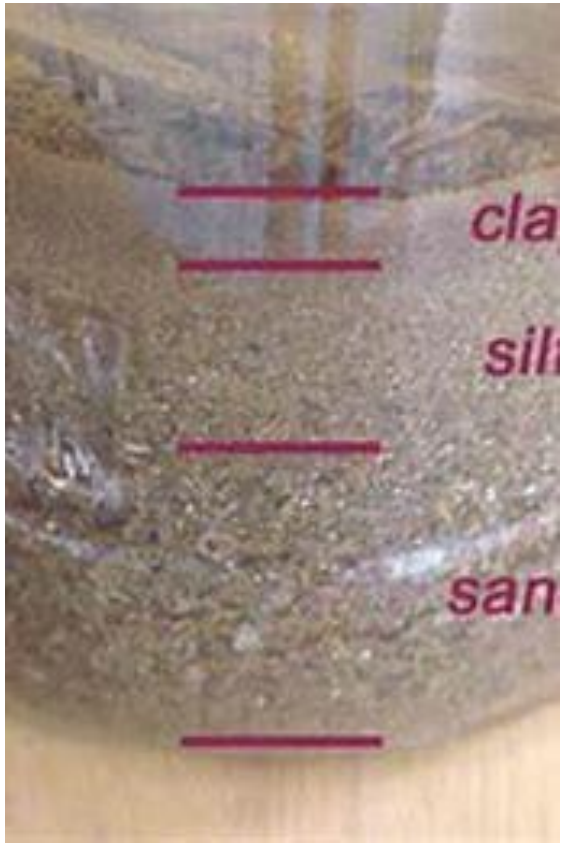
1) Know your soil available water holding capacity
2) Know your crop water requirements
3) Know your climate factors
4) Know your irrigation system efficiency



SOIL



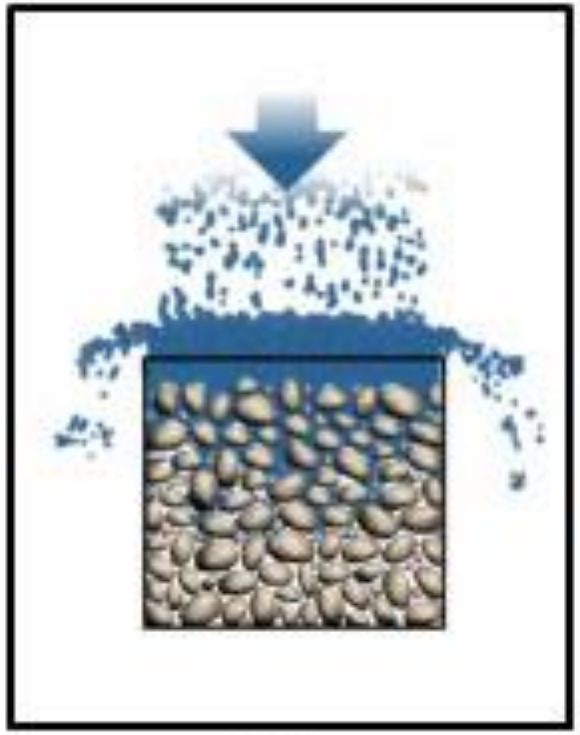




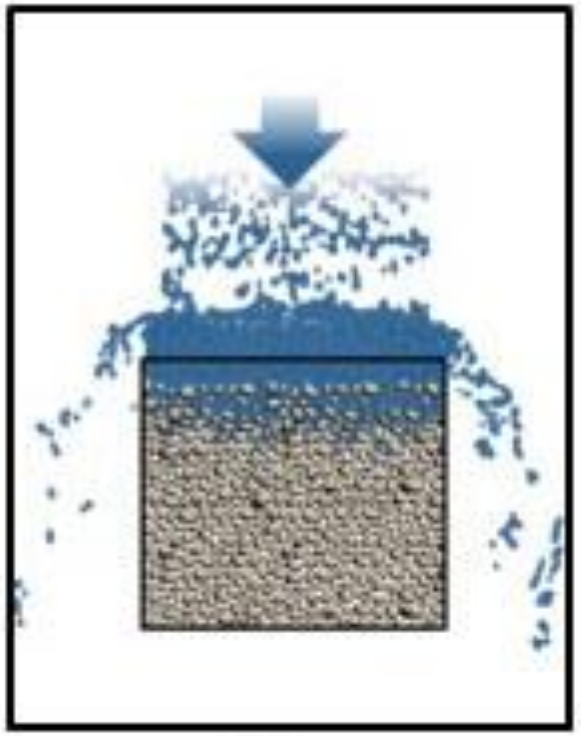
Soil Texture

Infiltration Variations by Soil Texture

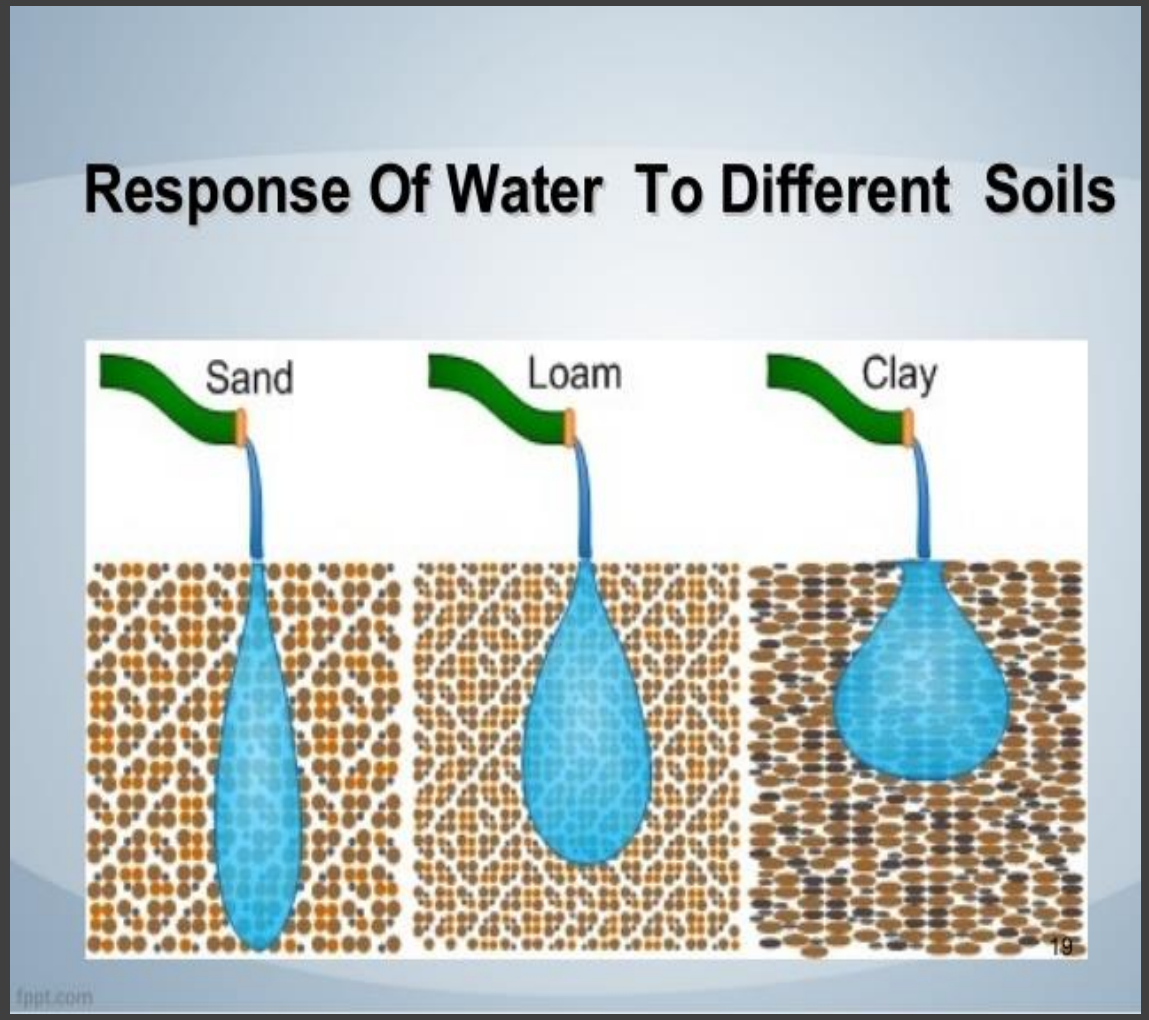
Sand



Silt



Clay



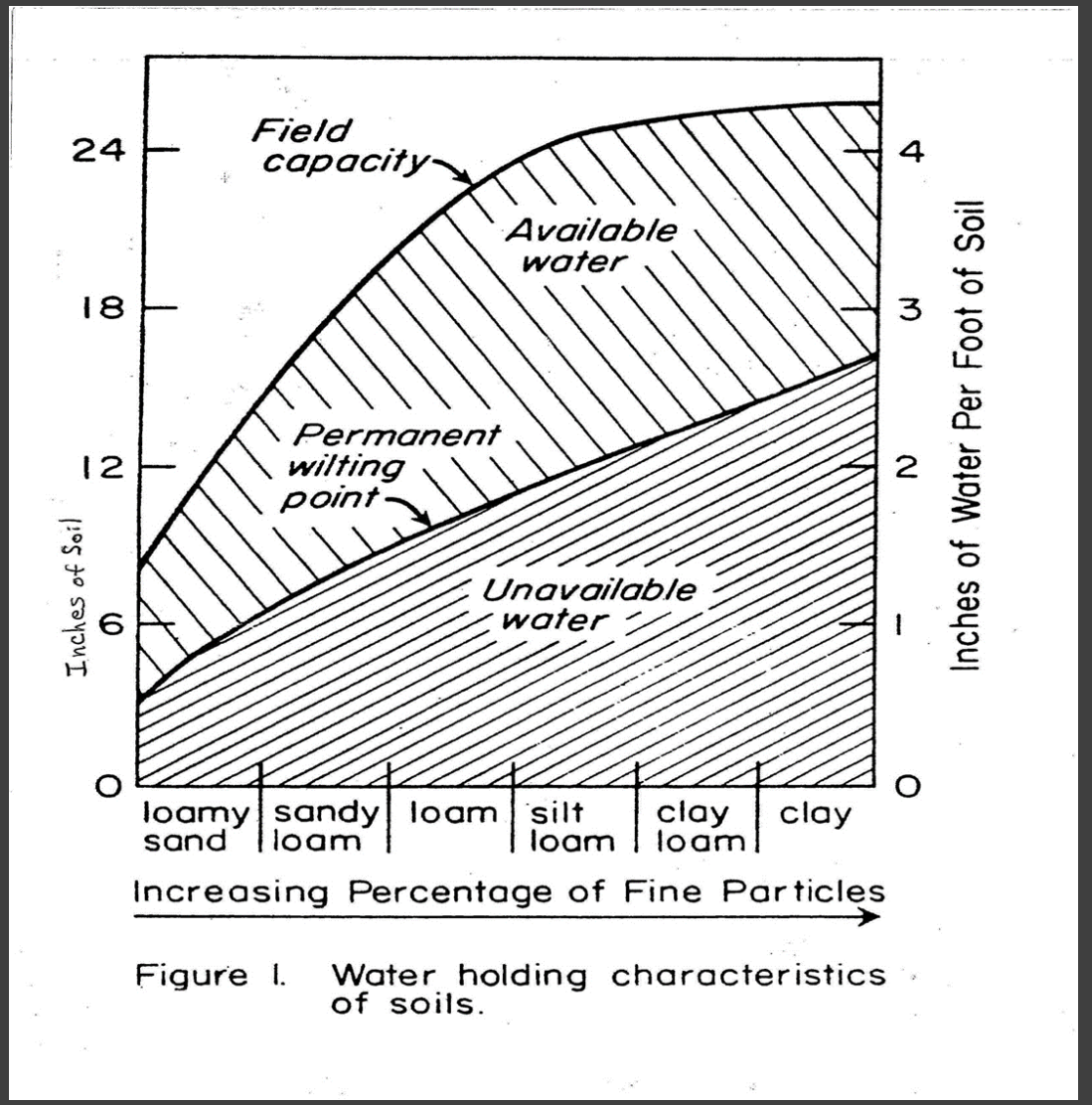
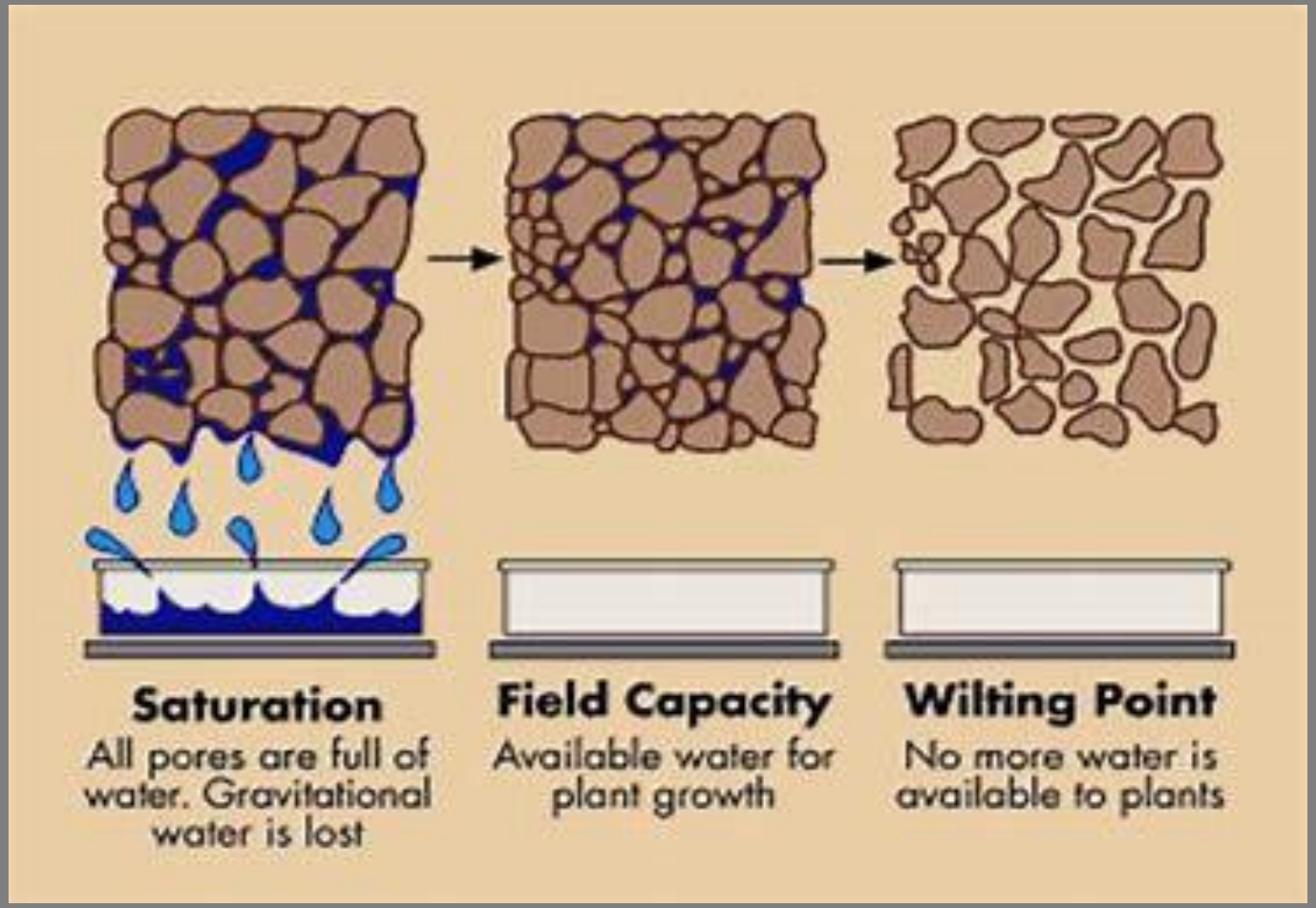


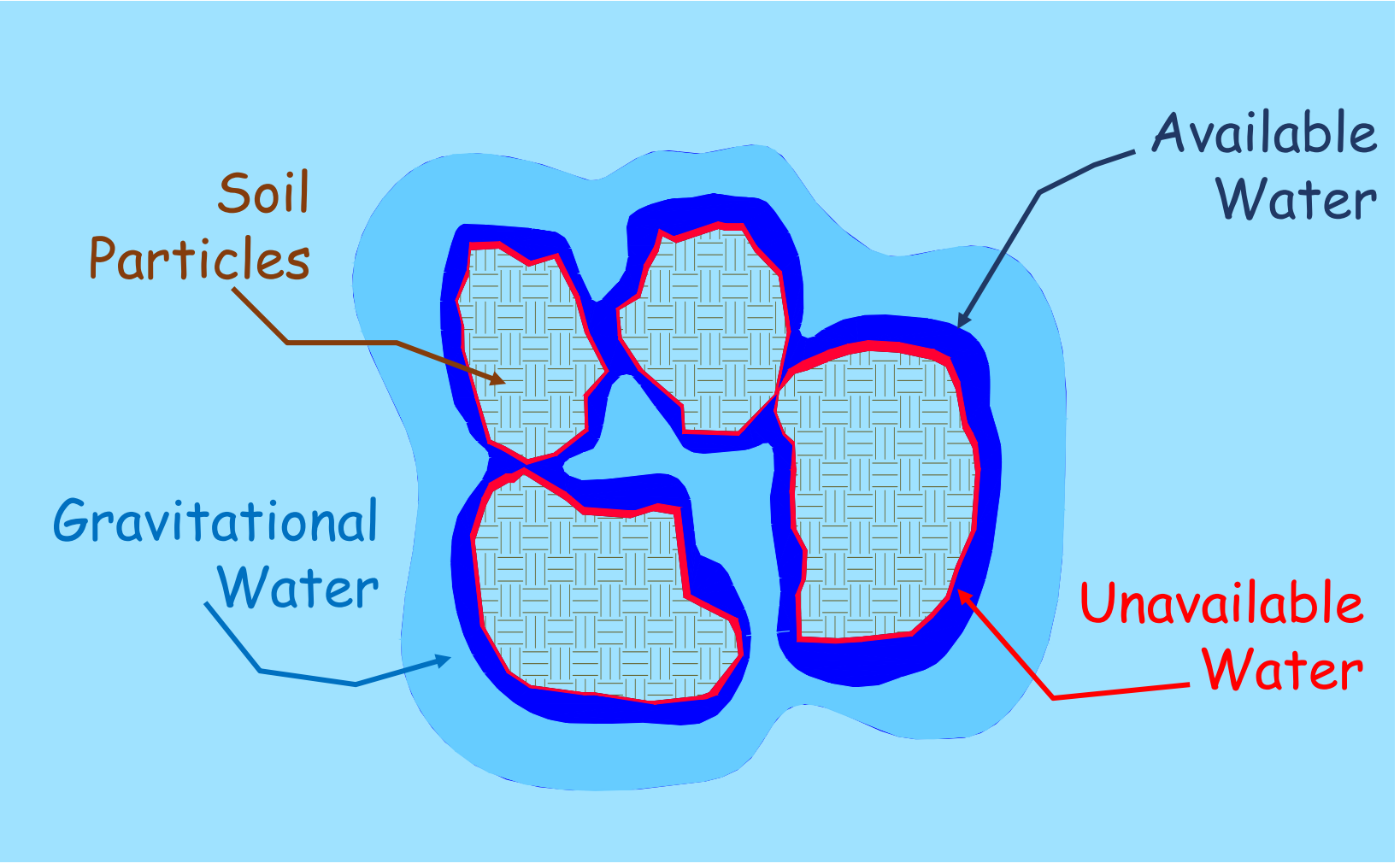
Figure 1. Water holding characteristics of soils.

Water Holding Capacity of Soil

Soil Water Retention



Soil-water relationship

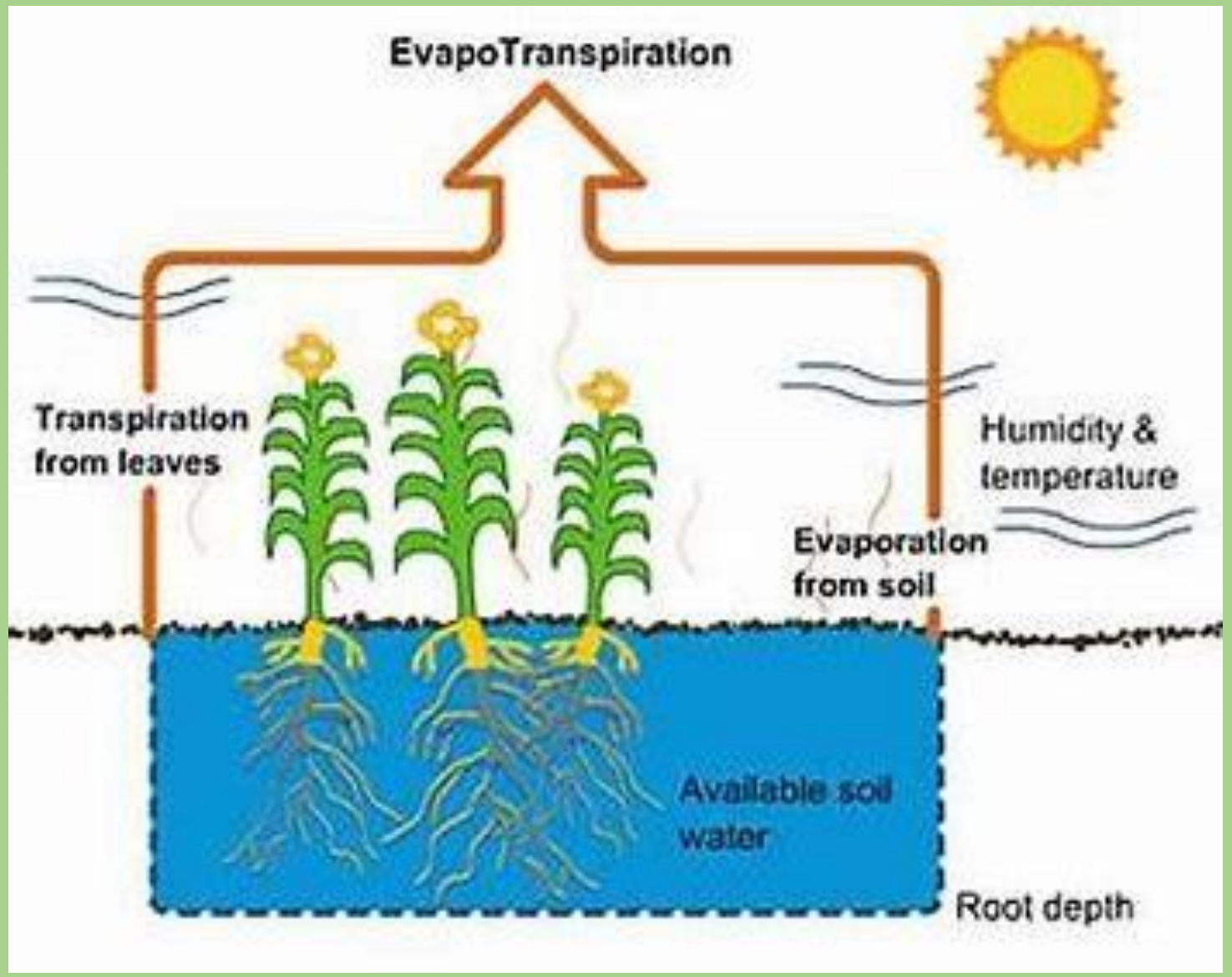


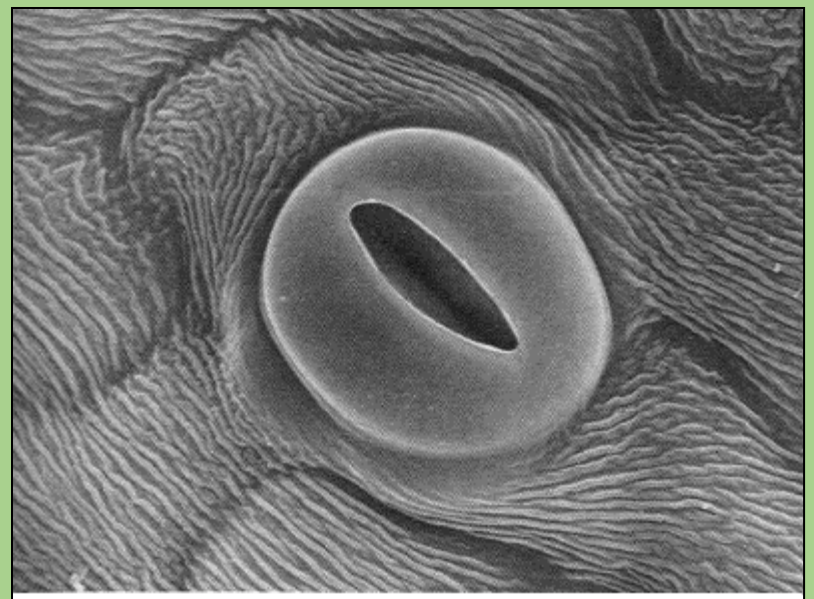
Why is AWC important?

Available water capacity (AWC) is used to calculate the amount of water needed for plant growth and determine the time needed for each irrigation (set time).


CROP

Plant Function





Photomicrograph of leaf surface showing one of the stomata.

Plant Transpiration

As a leafs guard cells shrink, stomata open and water is lost to the atmosphere through evaporation.

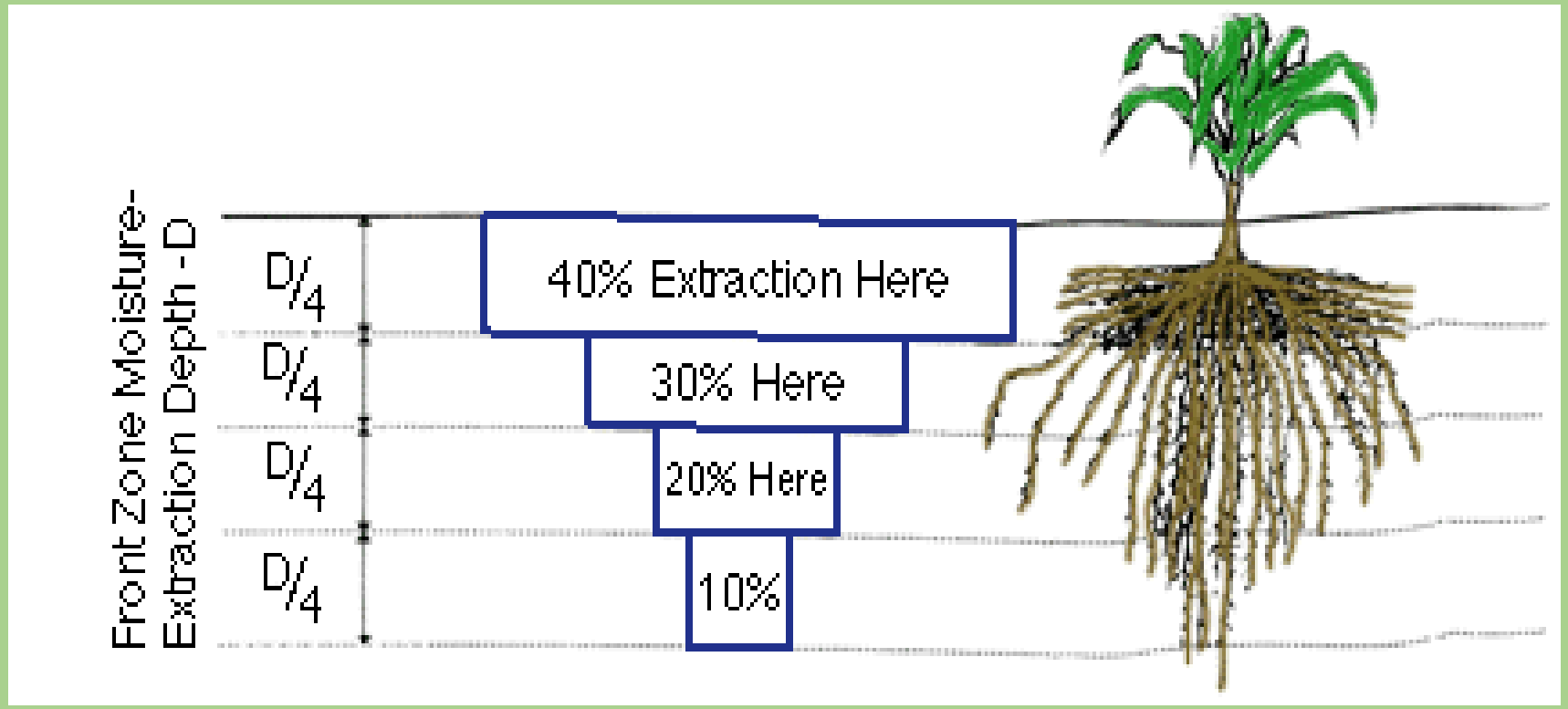
Transpiration is Responsible for:

- **Transporting soil minerals and nutrients throughout the plant**
- **Cooling the plant through evaporation**
- **Moving sugars and plant chemicals (for photosynthesis)**
- **Maintaining turgor pressure (keep plants hydrated).**

Effective Rooting Depth

“Depths to which the roots of mature crops will extract available soil water from a deep, uniform, well drained soil under unrestricted conditions”

Effective Root Depth = Depth of Managed Soil Water Reservoir



Management Allowable Depletion (MAD)

Is the percentage of available water that can safely be depleted without seriously affecting plant growth and development.

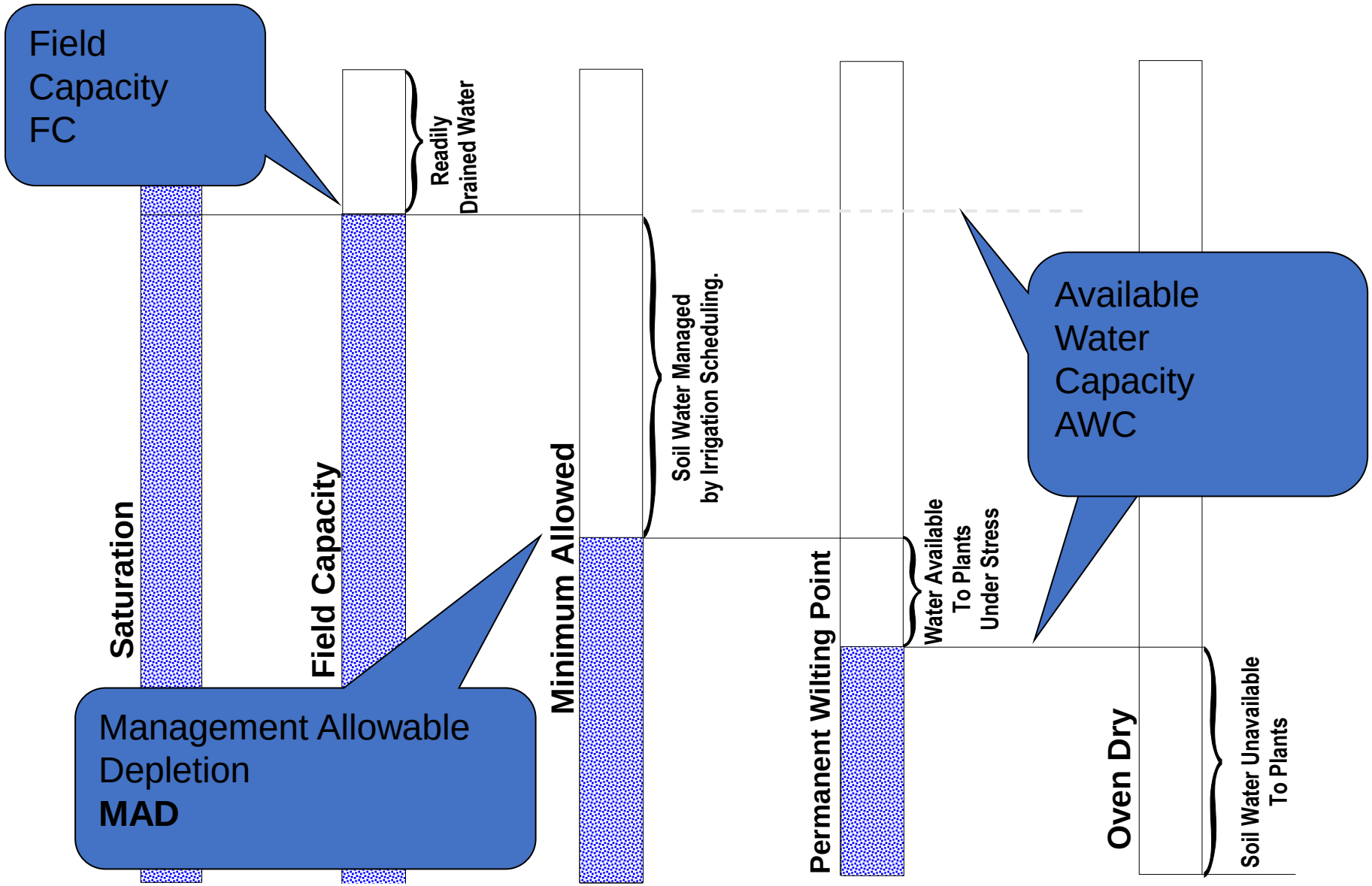
General rule of thumb for MAD values:

25 – 40% - most vegetable crops

50 – 60% - deep rooted crops (alfalfa, alfalfa-grass, grass pasture)

60 – 65% - gain crops

Soil Water Reservoir Definitions



CLIMATE

AgriMet

https://www.usbr.gov/pn/agrimet/

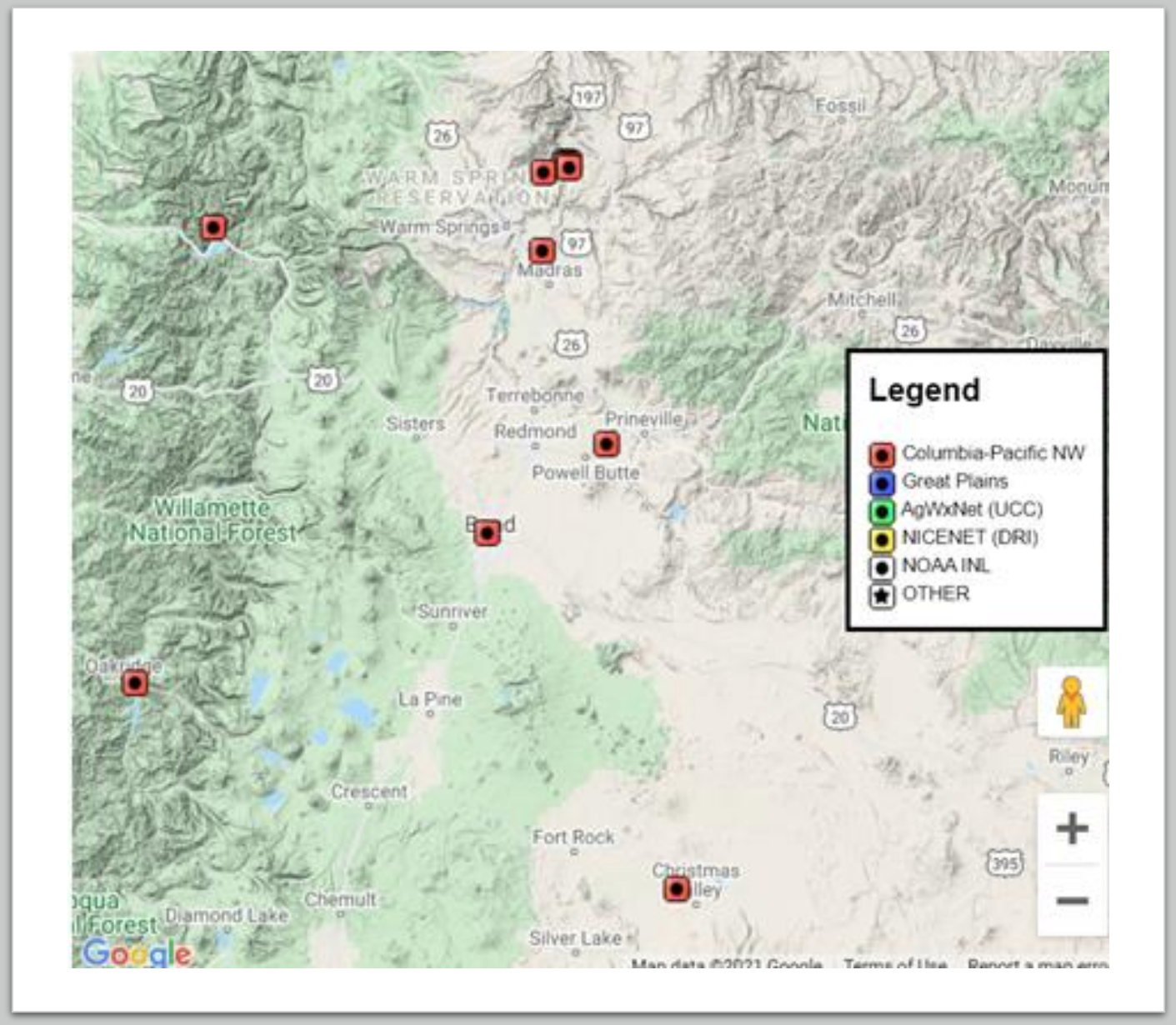
Local Weather Stations

Primary Weather Stations in Central Oregon:

Bend, Oregon AgriMet Weather Station (bewo) est. 2003

Madras, Oregon AgriMet Weather Station (mrso) est. 1984

Powell Butte, Oregon AgriMet Weather Station (pobo) est. 1993



Using AgriMet

Using AgriMet

Using AgriMet

Crop Water Use Information

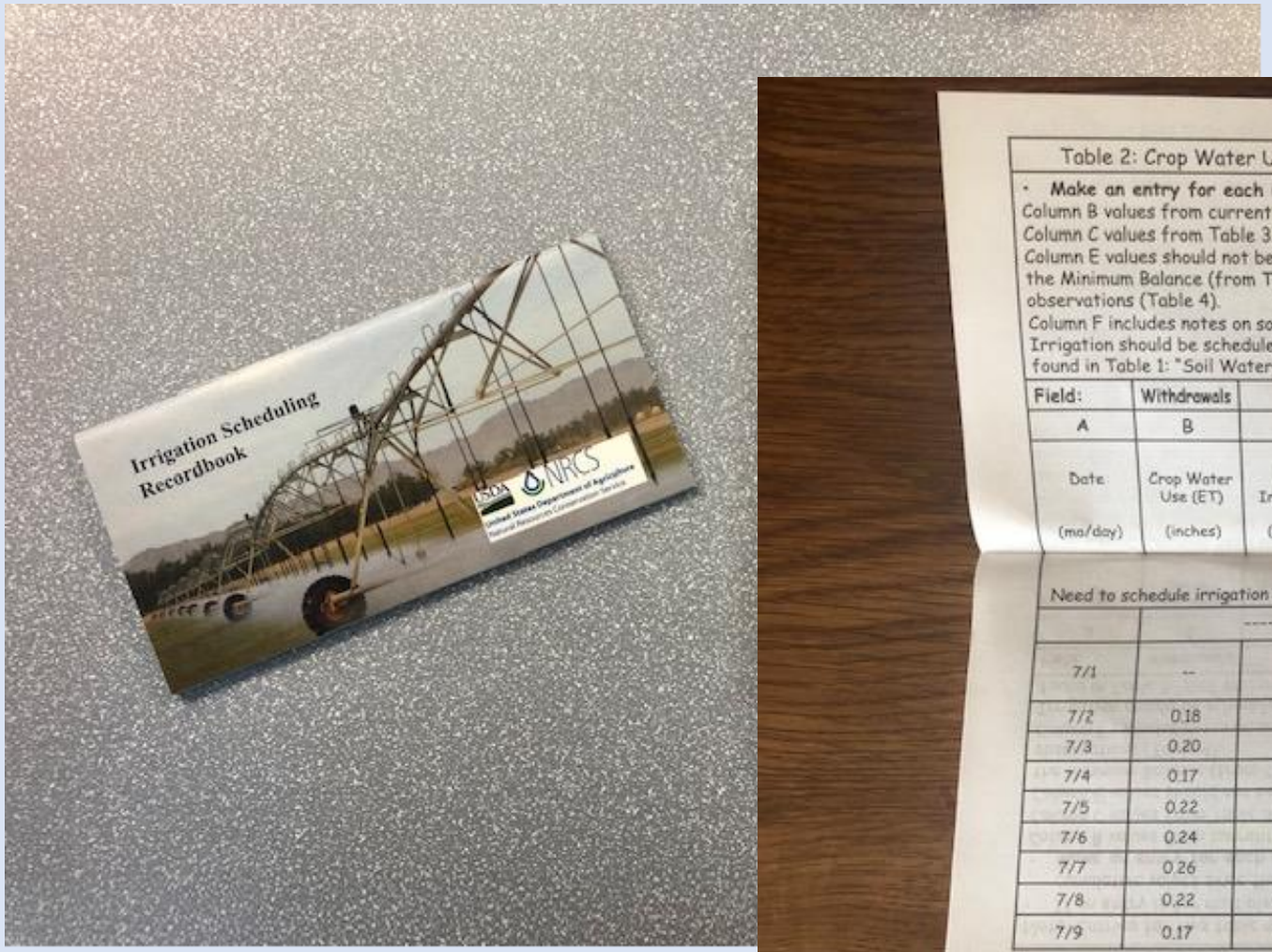
ESTIMATED CROP WATER USE - Apr 06, 2021 POBO

CROP	START DATE	DAILY CROP WATER USE-(IN) PENMAN ET - Apr 2	3	4	5	DAILY FORE CAST	COVER DATE	TERM DATE	SUM ET	7 DAY USE	14 DAY USE
ETr	03/20	0.24	0.16	0.17	0.17	0.17	03/20	10/25	2.6	1.4	2.4
ALFP	04/01	0.04	0.03	0.03	0.03	0.03	06/01	10/05	0.2	0.2	0.2
ALFM	04/01	0.04	0.03	0.03	0.03	0.03	06/01	10/05	0.2	0.2	0.2
HAYP	03/25	0.17	0.12	0.12	0.13	0.12	06/01	10/25	1.5	1.0	1.5
HAYM	03/25	0.17	0.12	0.12	0.13	0.12	06/01	10/25	1.5	1.0	1.5
PAST	03/25	0.08	0.05	0.06	0.06	0.06	05/20	10/05	0.7	0.4	0.7
LAWN	03/25	0.10	0.07	0.08	0.09	0.08	05/10	10/05	0.7	0.5	0.7
BLGR	03/25	0.10	0.07	0.08	0.08	0.07	05/20	07/20	0.8	0.6	0.8
WGRN	03/20	0.12	0.08	0.09	0.10	0.09	06/05	07/25	1.1	0.7	1.1
SGRN	04/15	0.00	0.00	0.00	0.00	0.00	07/01	08/05	0.0	0.0	0.0
SGRN	05/01	0.00	0.00	0.00	0.00	0.00	07/10	08/15	0.0	0.0	0.0
SGRN	05/15	0.00	0.00	0.00	0.00	0.00	07/20	08/25	0.0	0.0	0.0
SGRN	05/20	0.00	0.00	0.00	0.00	0.00	07/20	08/25	0.0	0.0	0.0
FCRN	05/20	0.00	0.00	0.00	0.00	0.00	07/25	09/25	0.0	0.0	0.0

POBO - ET SUMMARY - 2020

DATE	ETr	ALFP	ALFM	HAYP	HAYM	PAST	LAWN	BLGR	WGRN	SGRN	SGRN	SGRN	SGRN	FCRN	FCRN	SOYB	GAR
03/11	0.14	--	--	--	--	--	--	--	0.03	--	--	--	--	--	--	--	-
03/12	0.12	--	--	--	--	--	--	--	0.03	--	--	--	--	--	--	--	-
03/13	0.12	--	--	--	--	--	--	--	0.03	--	--	--	--	--	--	--	-
03/14	0.03	--	--	--	--	--	--	--	0.01	--	--	--	--	--	--	--	-
03/15	0.02	--	--	0.01	0.01	0.01	0.00	0.01	0.01	--	--	--	--	--	--	--	-
03/16	0.04	--	--	0.02	0.02	0.01	0.01	0.01	0.01	--	--	--	--	--	--	--	-
03/17	0.08	--	--	0.05	0.05	0.02	0.01	0.03	0.03	--	--	--	--	--	--	--	-
03/18	0.09	--	--	0.06	0.06	0.02	0.02	0.03	0.04	--	--	--	--	--	--	--	-
03/19	0.11	--	--	0.07	0.07	0.03	0.02	0.04	0.05	--	--	--	--	--	--	--	-
03/20	0.13	0.02	0.02	0.09	0.09	0.04	0.03	0.05	0.06	--	--	--	--	--	--	--	-
03/21	0.14	0.02	0.02	0.09	0.09	0.04	0.04	0.05	0.06	--	--	--	--	--	--	--	-
03/22	0.16	0.03	0.03	0.11	0.11	0.05	0.05	0.06	0.08	--	--	--	--	--	--	--	-
03/23	0.15	0.03	0.03	0.11	0.11	0.05	0.06	0.06	0.07	--	--	--	--	--	--	--	-
03/24	0.09	0.02	0.02	0.06	0.06	0.03	0.04	0.04	0.05	--	--	--	--	--	--	--	-
03/25	0.08	0.02	0.02	0.06	0.06	0.03	0.04	0.04	0.04	--	--	--	--	--	--	--	-
03/26	0.11	0.02	0.02	0.08	0.08	0.04	0.06	0.05	0.06	--	--	--	--	--	--	--	-
03/27	0.08	0.02	0.02	0.06	0.06	0.03	0.04	0.04	0.05	--	--	--	--	--	--	--	-
03/28	0.09	0.02	0.02	0.07	0.07	0.03	0.05	0.05	0.05	--	--	--	--	--	--	--	-
03/29	0.16	0.05	0.05	0.12	0.12	0.06	0.09	0.09	0.10	--	--	--	--	--	--	--	-
03/30	0.13	0.04	0.04	0.10	0.10	0.05	0.08	0.08	0.08	--	--	--	--	--	--	--	-
03/31	0.09	0.03	0.03	0.07	0.07	0.04	0.06	0.05	0.06	--	--	--	--	--	--	--	-
04/01	0.09	0.04	0.04	0.07	0.07	0.04	0.06	0.06	0.06	--	--	--	--	--	--	--	-
04/02	0.08	0.03	0.03	0.07	0.07	0.04	0.05	0.05	0.05	--	--	--	--	--	--	--	-
04/03	0.11	0.05	0.05	0.09	0.09	0.05	0.08	0.08	0.08	--	--	--	--	--	--	--	-
04/04	0.07	0.03	0.03	0.06	0.06	0.03	0.05	0.05	0.05	--	--	--	--	--	--	--	-
04/05	0.07	0.04	0.04	0.06	0.06	0.03	0.05	0.05	0.05	--	--	--	--	--	--	--	-
04/06	0.10	0.05	0.05	0.09	0.09	0.05	0.07	0.08	0.07	--	--	--	--	--	--	--	-
04/07	0.16	0.09	0.09	0.14	0.14	0.08	0.12	0.13	0.12	--	--	--	--	--	--	--	-
04/08	0.20	0.12	0.12	0.17	0.17	0.11	0.15	0.16	0.15	--	--	--	--	--	--	--	-
04/09	0.20	0.12	0.12	0.17	0.17	0.11	0.15	0.17	0.16	--	--	--	--	--	--	--	-
04/10	0.25	0.16	0.16	0.22	0.22	0.14	0.19	0.21	0.20	0.05	--	--	--	--	--	--	-
04/11	0.27	0.17	0.17	0.24	0.24	0.16	0.21	0.23	0.22	0.05	--	--	--	--	--	--	-
04/12	0.16	0.11	0.11	0.14	0.14	0.10	0.13	0.14	0.13	0.03	--	--	--	--	--	--	-
04/13	0.17	0.12	0.12	0.15	0.15	0.10	0.14	0.15	0.14	0.03	--	--	--	--	--	--	-
04/14	0.25	0.17	0.17	0.22	0.22	0.15	0.20	0.22	0.21	0.05	--	--	--	--	--	--	-

Checkbook Method



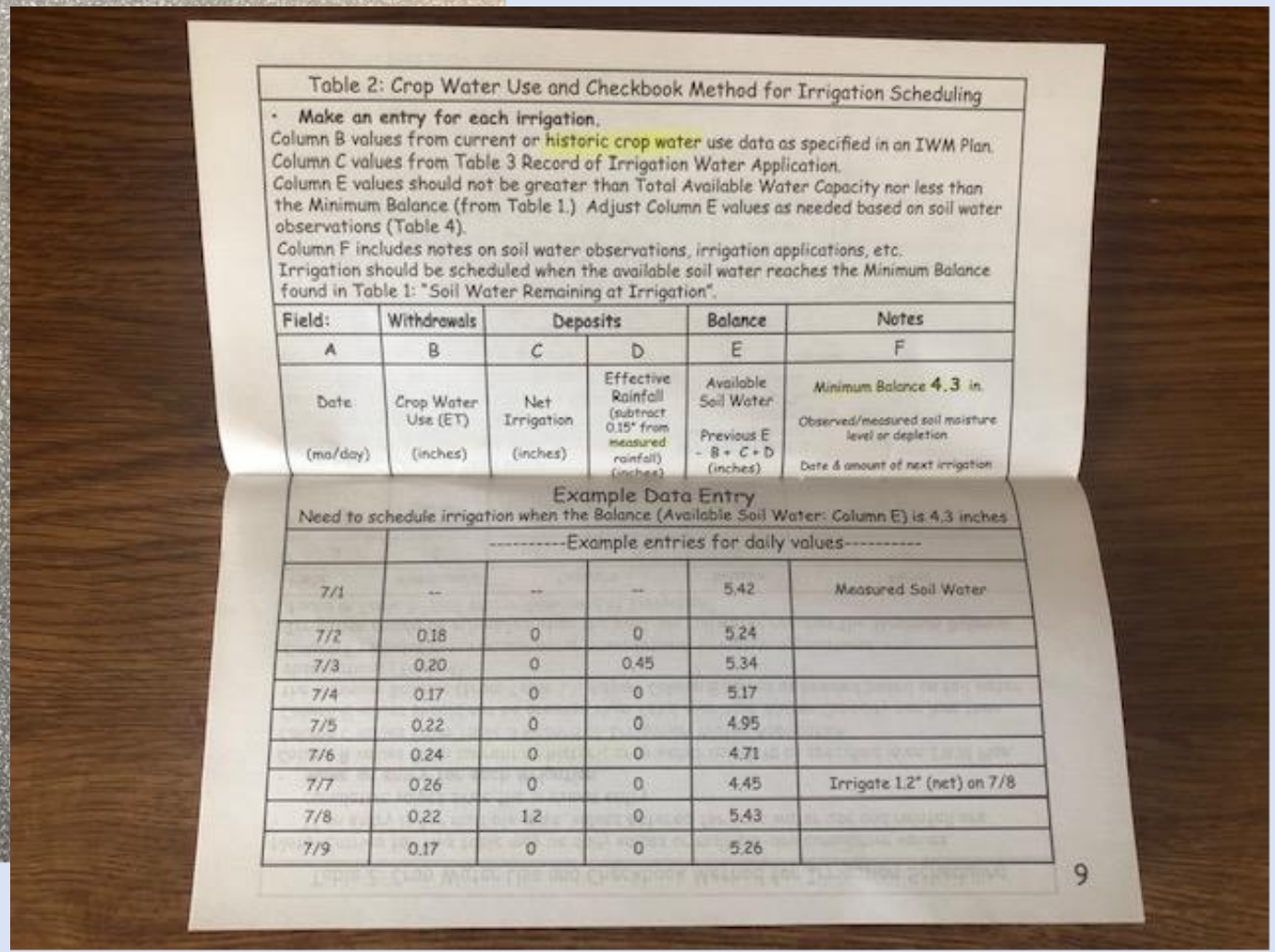


Table 2: Crop Water Use and Checkbook Method for Irrigation Scheduling

- **Make an entry for each irrigation.**

Column B values from current or historic crop water use data as specified in an IWM Plan.
Column C values from Table 3 Record of Irrigation Water Application.
Column E values should not be greater than Total Available Water Capacity nor less than the Minimum Balance (from Table 1.) Adjust Column E values as needed based on soil water observations (Table 4).
Column F includes notes on soil water observations, irrigation applications, etc.
Irrigation should be scheduled when the available soil water reaches the Minimum Balance found in Table 1: "Soil Water Remaining at Irrigation".

Field:	Withdrawals	Deposits		Balance	Notes
A	B	C	D	E	F
Date (mo/day)	Crop Water Use (ET) (inches)	Net Irrigation (inches)	Effective Rainfall (subtract 0.15" from measured rainfall) (inches)	Available Soil Water Previous E - B + C + D (inches)	Minimum Balance 4.3 in. Observed/measured soil moisture level or depletion Date & amount of next irrigation
Example Data Entry					
Need to schedule irrigation when the Balance (Available Soil Water: Column E) is 4.3 inches					
	----------Example entries for daily values----------				
7/1	--	--	--	5.42	Measured Soil Water
7/2	0.18	0	0	5.24	
7/3	0.20	0	0.45	5.34	
7/4	0.17	0	0	5.17	
7/5	0.22	0	0	4.95	
7/6	0.24	0	0	4.71	
7/7	0.26	0	0	4.45	Irrigate 1.2" (net) on 7/8
7/8	0.22	1.2	0	5.43	
7/9	0.17	0	0	5.26	

9

Irrigation System Efficiency

Application Efficiencies for Different Irrigation Systems

Sprinkler Systems

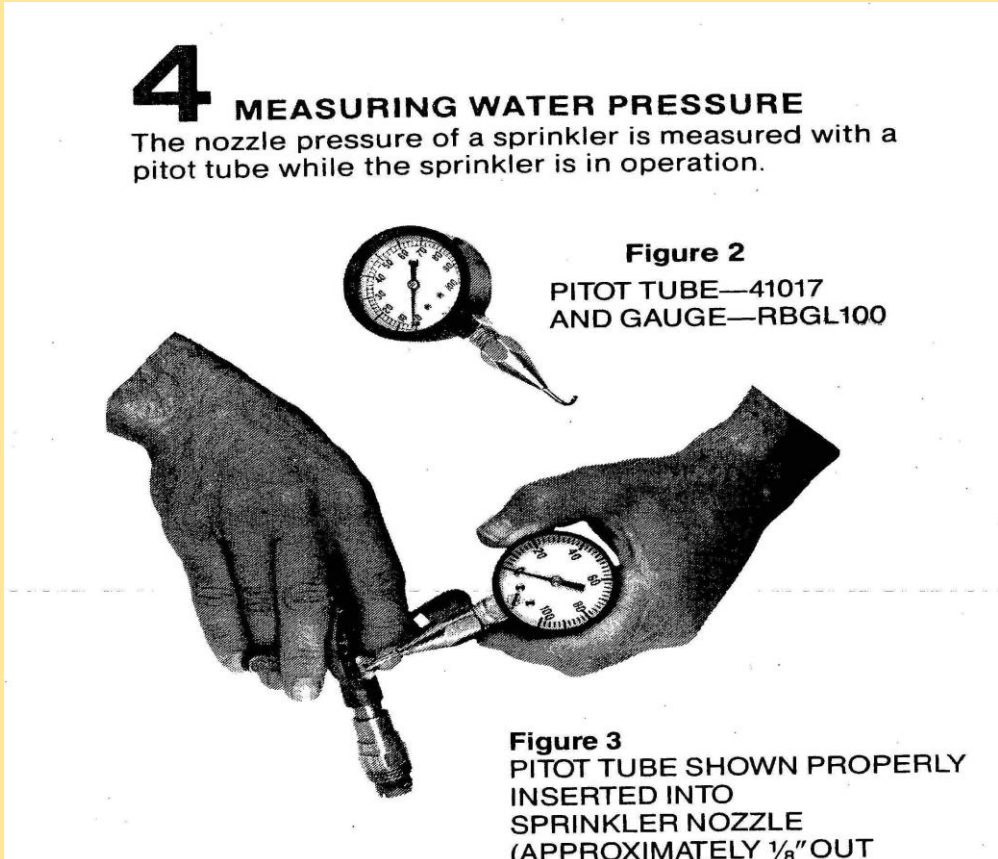
Linear move	75-90
Center pivot (low pressure)	75-90
Fixed solid set	70-85
Center pivot (high pressure)	65-80
Hand move or side roll laterals	60-75
Traveling gun	60-70
Stationary gun	50-60

Microirrigation systems

Surface/subsurface drip	85-95
Micro spray or mist	85-90

Know your flow rate

Nozzles tend to enlarge with constant use. As they enlarge, they allow more water to pass, resulting in poor uniformity of application.



4 MEASURING WATER PRESSURE

The nozzle pressure of a sprinkler is measured with a pitot tube while the sprinkler is in operation.

Figure 2
PITOT TUBE—41017
AND GAUGE—RBGL100

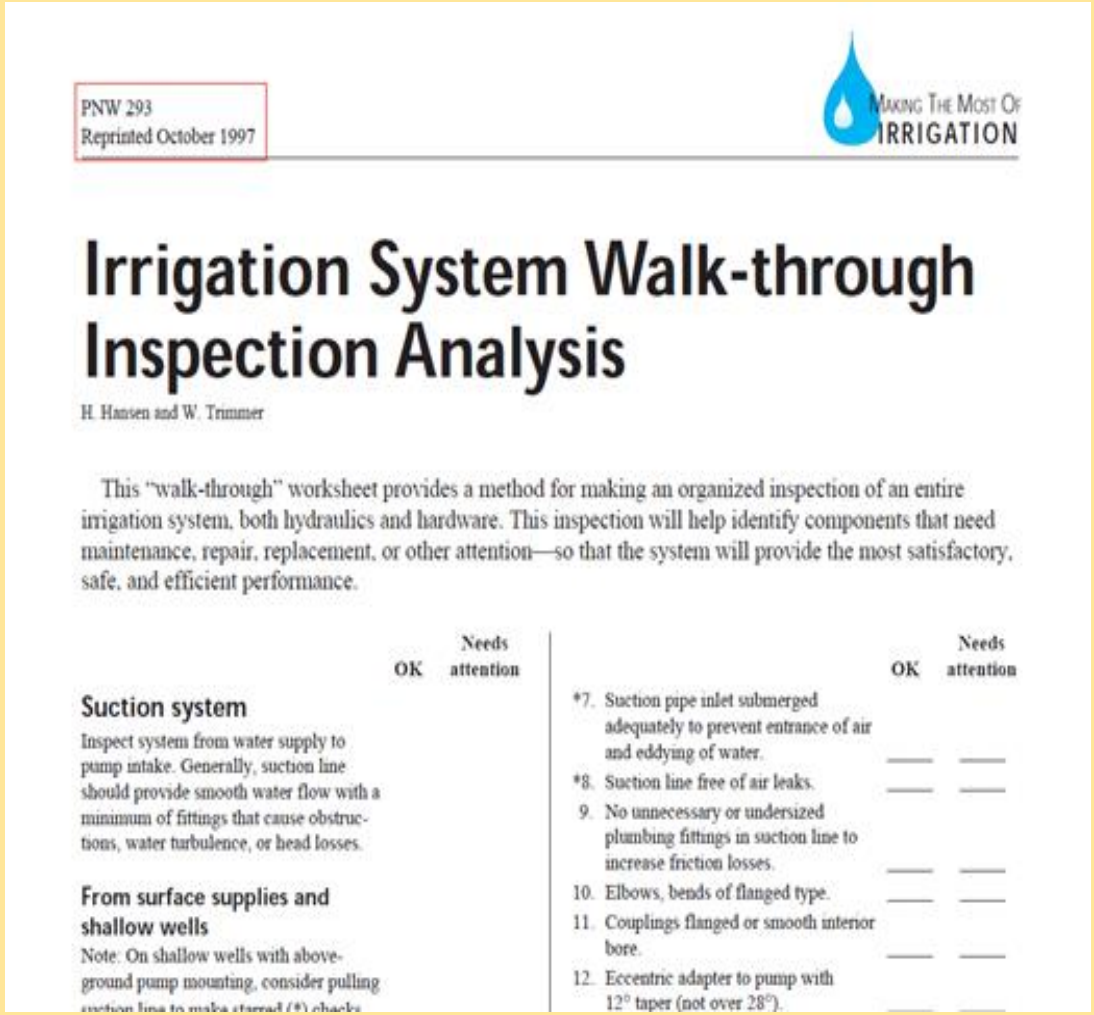
Figure 3
PITOT TUBE SHOWN PROPERLY INSERTED INTO SPRINKLER NOZZLE (APPROXIMATELY ⅛" OUT

Know your flow rate

Table 1 - Nozzle discharge (gpm)

Nozzle Size (inches)	Nozzle Pressure, psi 30	40	50	60	70
3/32	1.4	1.7	1.9	2	2.1
1.8	2.6	3	3.3	3.5	3.8
9/64	3.3	3.7	4.2	4.5	4.9
5/32	3.9	4.5	5	5.4	5.8
11/64	4.7	5.4	6	6.6	7.1
3/16	5.5	6.3	7	7.7	8.3
13/64	6.4	7.4	8.2	9	9.7
7/32	7.4	8.6	9.6	10.5	11.3

Irrigation System Inspection



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MAKING THE MOST OF IRRIGATION

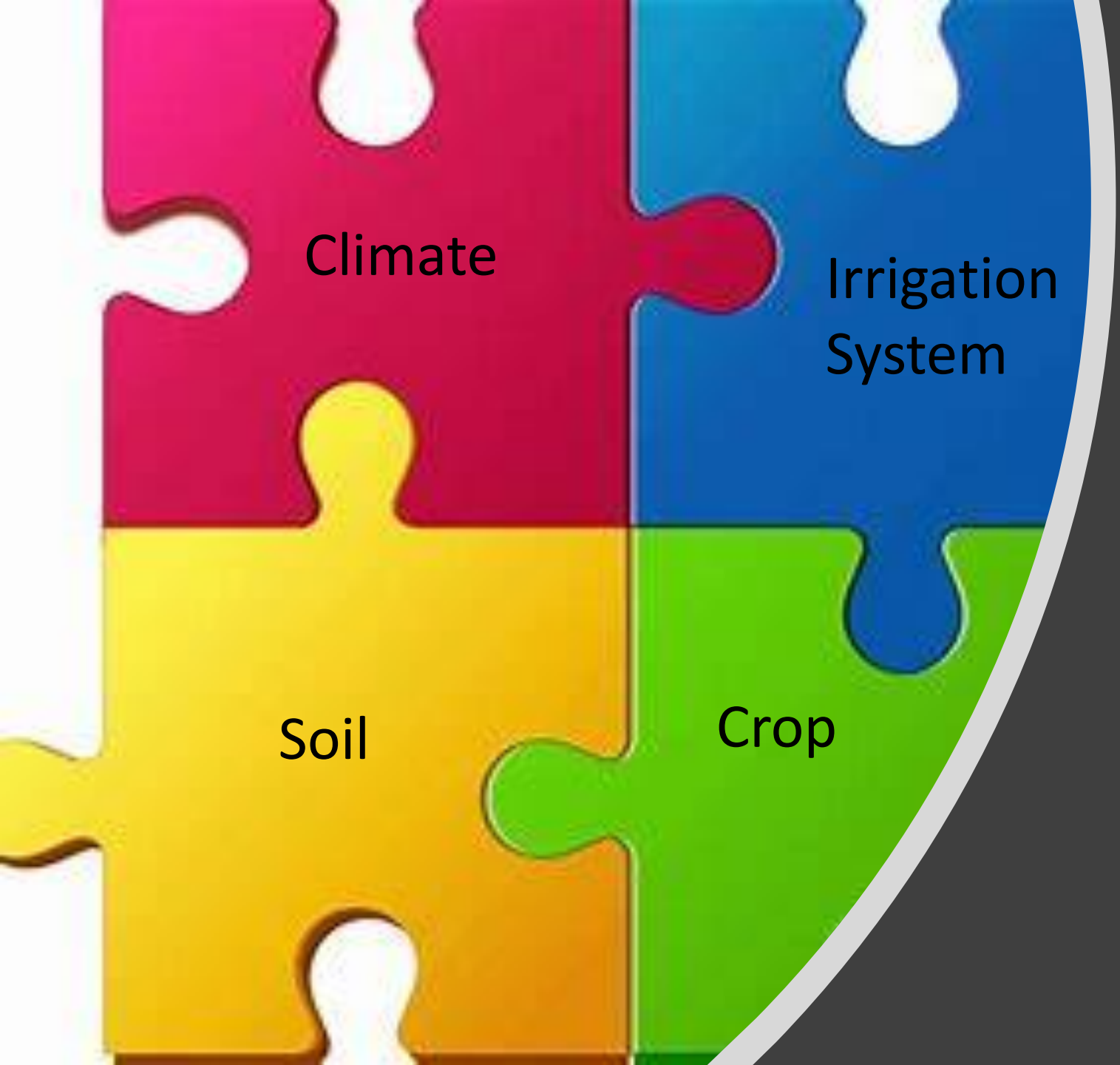
Irrigation System Walk-through Inspection Analysis

H. Hansen and W. Trimmer

This "walk-through" worksheet provides a method for making an organized inspection of an entire irrigation system, both hydraulics and hardware. This inspection will help identify components that need maintenance, repair, replacement, or other attention—so that the system will provide the most satisfactory, safe, and efficient performance.

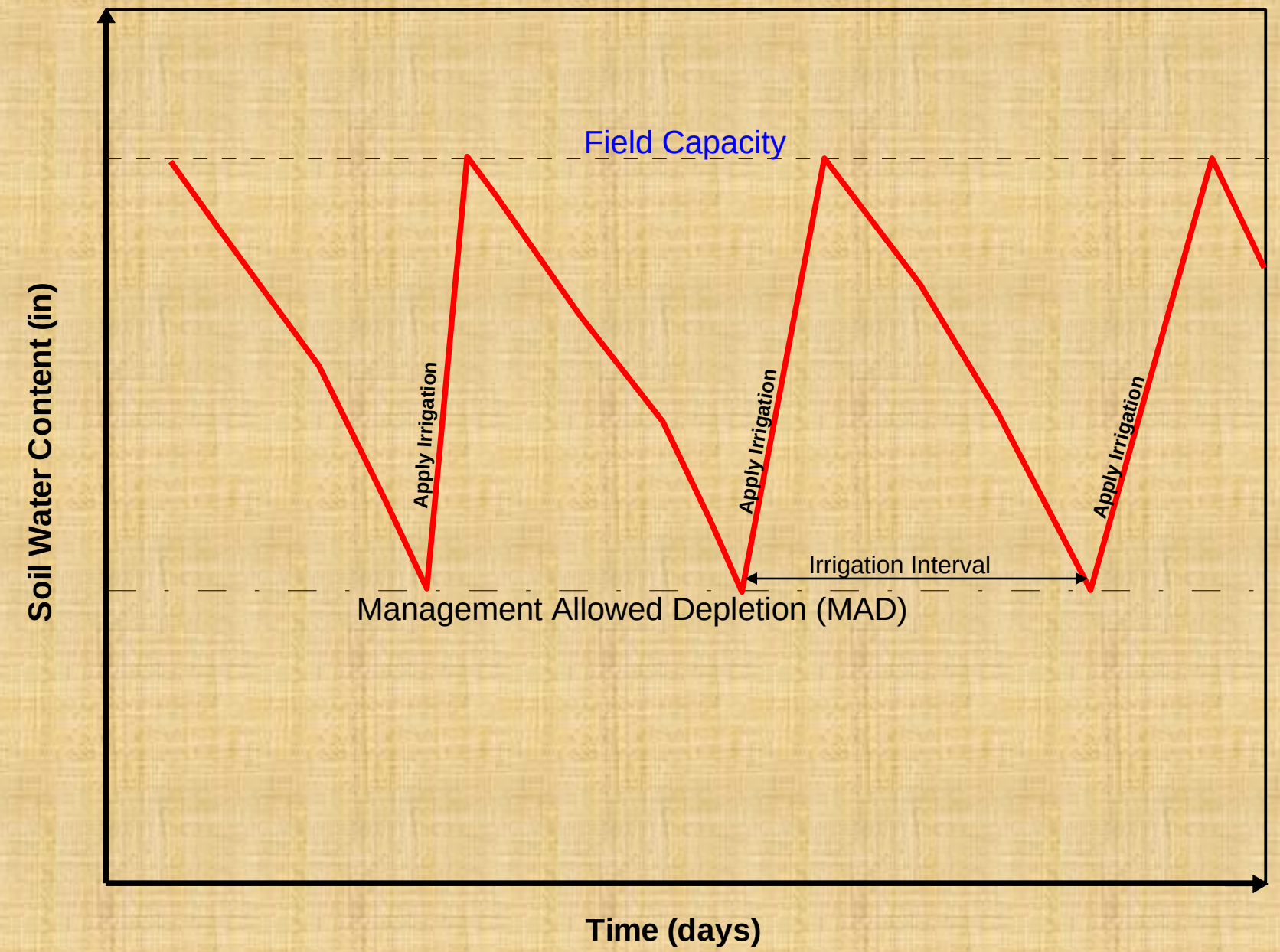
	OK	Needs attention
Suction system		
Inspect system from water supply to pump intake. Generally, suction line should provide smooth water flow with a minimum of fittings that cause obstructions, water turbulence, or head losses.		
From surface supplies and shallow wells		
Note: On shallow wells with above-ground pump mounting, consider pulling suction line to make starred (*) checks		
*7. Suction pipe inlet submerged adequately to prevent entrance of air and eddying of water.	___	___
*8. Suction line free of air leaks.	___	___
9. No unnecessary or undersized plumbing fittings in suction line to increase friction losses.	___	___
10. Elbows, bends of flanged type.	___	___
11. Couplings flanged or smooth interior bore.	___	___
12. Eccentric adapter to pump with 12° taper (not over 28°).	___	___

- **Repair leaks and malfunctioning nozzles.**
- **Use the same nozzle size on each line.**
- **Use closer spacing, boom mounted nozzles, and / or rotating-type nozzles for center pivot systems.**
- **Maintain adequate pressure (50-60 psi) by:**
  - **Adjusting the pump impeller of semi-open impellers,**
  - **Repairing or replacing worn pump, or**
  - **Reducing the number of laterals operating**
- **Replace gaskets**
- **Inspect risers**
- **Test pressure relief valves**
- **Check pump impellors**



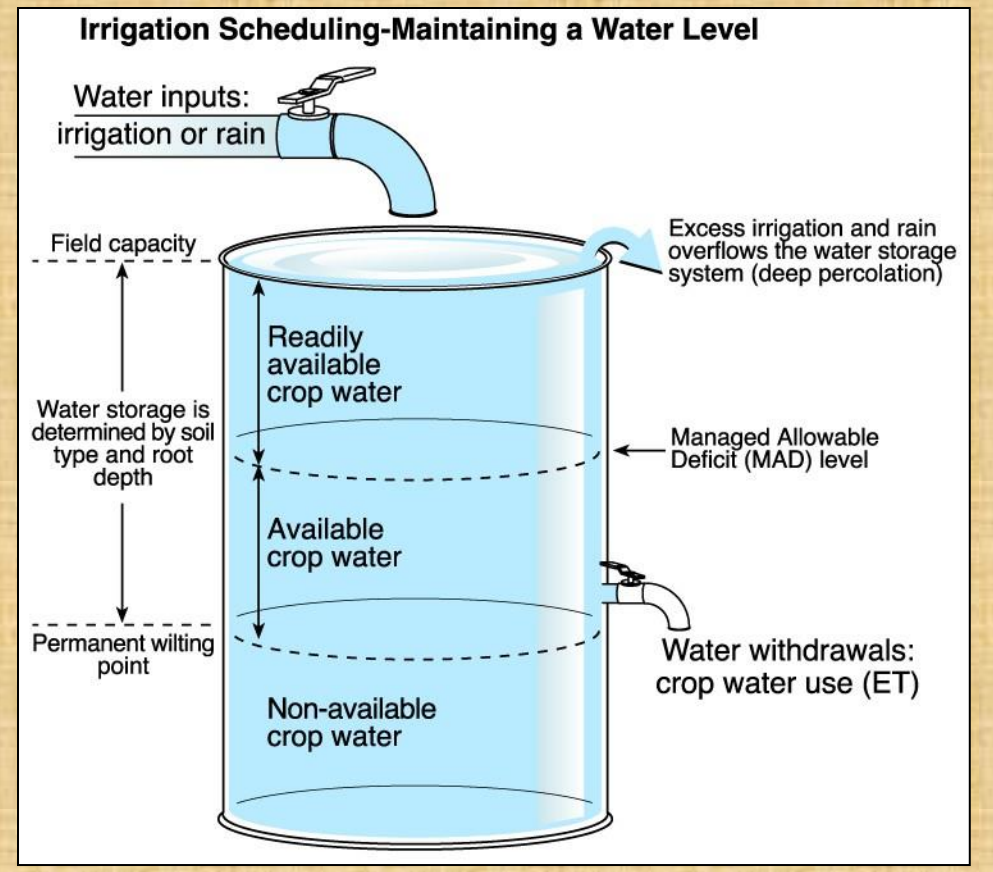
IRRIGATION SCHEDULING

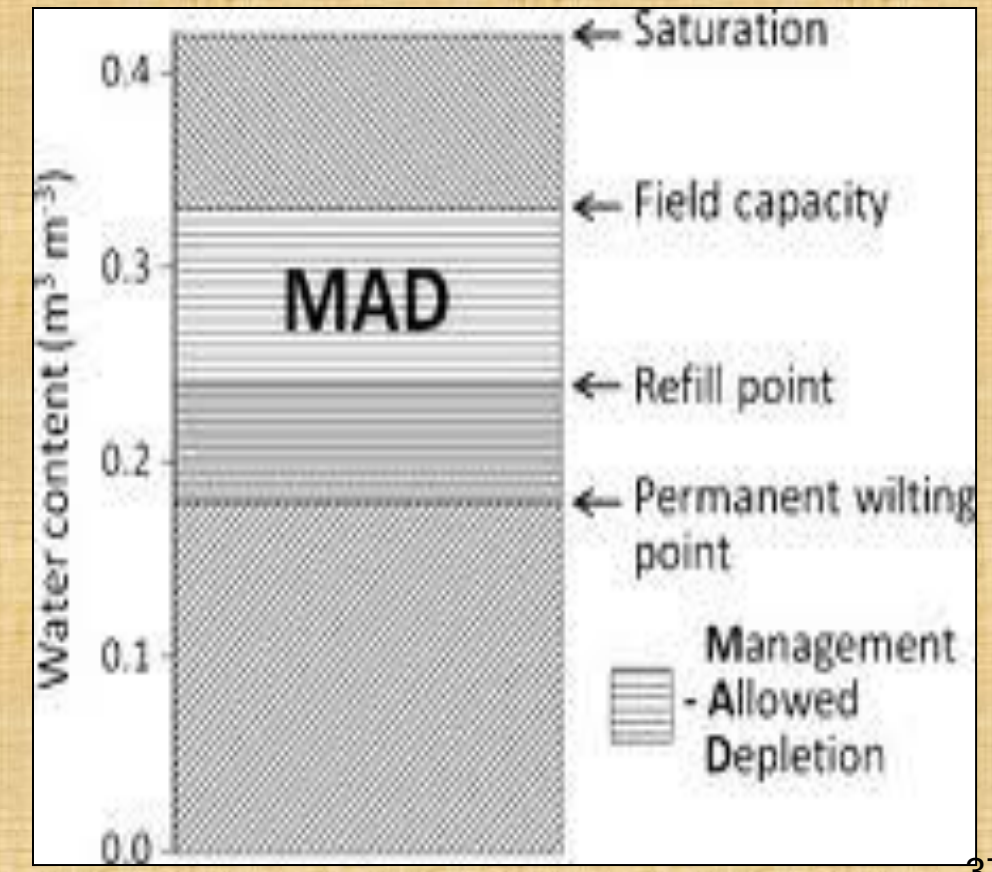
Deficit Irrigation



Management Allowed Depletion (MAD)

"Management Strategy to determine how far below field capacity the irrigator allows the soil moisture to go before applying irrigation water.





IWM Example – Set time

Sprinkler System Info:

- Nozzle = 5 gpm (5/32 @ 50 psi)
- Lateral (Riser) spacing = 50 feet
- Nozzle Spacing = 40 feet
- Conversion Factor = 96.3
- System Efficiency Factor = 65%

➢ **Sprinkler Application Rate = (96.3 x 5 gpm) ÷ (50' x 40') = 0.24 in/hr**

Crop and Soil Info:

- Crop = Grass Hay
- Soil Profile Managed = 2 ft
- AWC = 1.5 in/ft of soil,
- MAD = 50%
- Manage root zone 2 ft x 1.5 in/ft x 50% = **1.5 inches soil water = Net Irrigation Application**
- ET = 0.30 in/day

➢ **Gross Application = Net Irrigation ÷ Efficiency (1.5" ÷ 0.65 = 2.31")**

➢ **Set Time = Gross Application ÷ Sprinkler Application Rate (2.31" ÷ 0.24 in/hr = 9.6 hr set)**

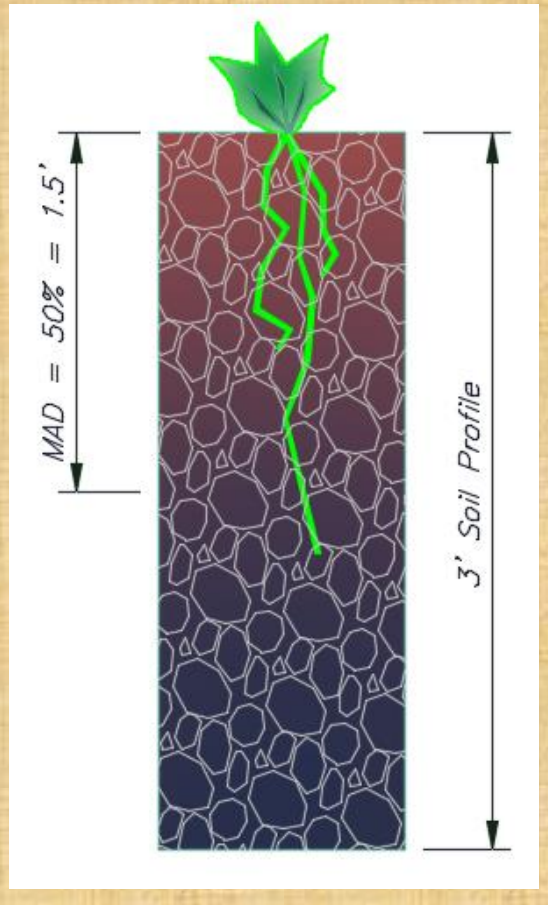
➢ **Irrigation Interval = Net Irrigation Application ÷ ET (1.5" ÷ 0.30 in/day = 5 days)**

Irrigation Scheduling Example #2

- Soil Depth: 3 feet
- Water Holding Capacity (texture): 1.5 in/foot
- The Maximum Allowable Depletion for alfalfa = 50%
- Total Water Holding Capacity:

  1.5 in/ft x 3 feet x 0.50 = 2.25 inches

2.25" of Water
in 1.5" of Soil



Irrigation Scheduling Example #2 (cont'd)

alfalfa w 3 ft. Soil @ 50% MAD & AWC = 1.5 in/ft soil, manages 2.25 inches soil water

- Available Water / ET = Irrigation Interval
  - Example 2.25" / 0.10" = 22 day Irrigation Interval

Available Water (@50% MAD)	ET	Irrigation Interval
2.25"	0.05"	45 days
2.25"	0.10"	22 days
2.25"	0.20"	11 days
2.25"	0.30"	7.5 days
2.25"	0.40"	5 days

Irrigation Scheduling Example #3

alflafa w 2 ft. Soil @ 50% MAD & AWC = 1.0 in/ft soil, manages 1 inches soil water

- Available Water / ET = Irrigation Interval
  - Example 1.0” / 0.10” = 10 day Irrigation Interval

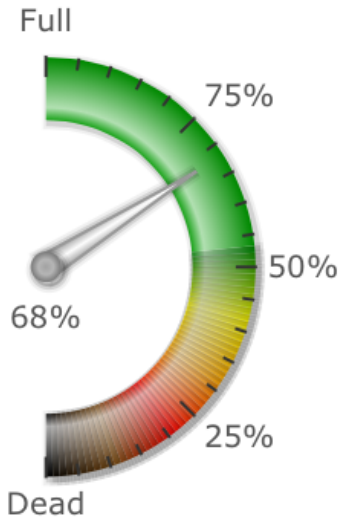
Available Water (@65% MAD)	ET	Irrigation Interval
1.0”	0.05”	20 days
1.0”	0.10”	10 days
1.0”	0.20”	5 days
1.0”	0.30”	3 days
1.0”	0.40”	2.5 days

irrigation scheduler mobile

Soil Water Dashboard

Field:

N Pod Pasture, 2014; Grass (Pasture)



This Morning's Soil Water Deficit:	0.9 in. or 5.4 hrs
Today's Irrigation:	0.00 hrs

I Irrigated Today: ☐ hrs

Save

Green is good. Crops increasingly stressed below green.

Dashboard

Daily Budget Table

Soil Water Chart

More Charts

Irrigation Scheduling

- ✓ Repair and replace worn irrigation equipment
- ✓ Use the estimating soil moisture field test to determine Available Water Capacity (AWC) or soil moisture meter
- ✓ Know your AWC for your soil type
- ✓ Know your crop and rooting depth
- ✓ Know your Management Allowable Depletion (MAD) for the crop
- ✓ Document when and how long you irrigate – checkbook method
- ✓ And Save Water!

THANK YOU !

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