ASIC 2016
CALIFORNIA REGIONAL CONFERENCE

May 15 – 16, 2016

San Luis Obispo, CA

ASIC 2016 REGIONAL CONFERENCES

Southeast, Southwest, Northeast, & California

American Society of Irrigation Consultants

Tim Barr

California's Drought and Water Use Efficiency

Tim Barr, Director of Water Resources
Western Municipal Water District of Riverside County

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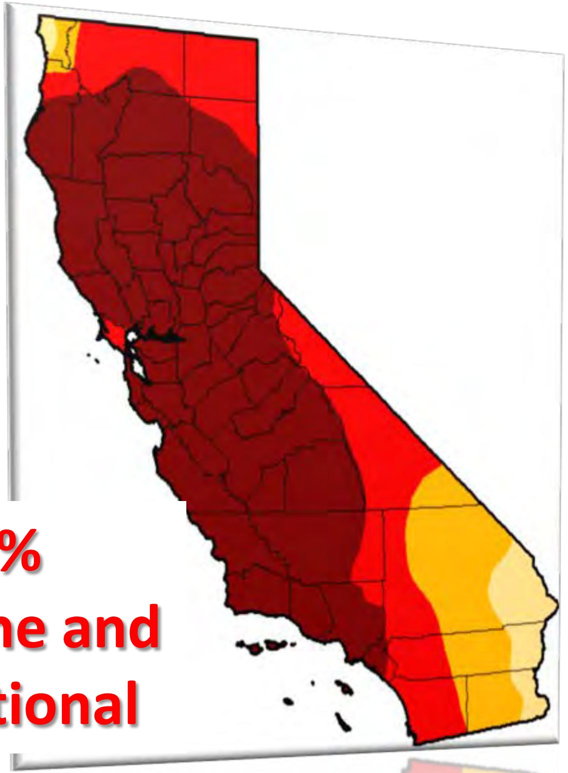
Unprecedented Conditions



82% Extreme and Exceptional

Calendar Year 2013

Driest on record

January 2014

Lowest snowpack

WY 2014

4^{th} lowest runoff

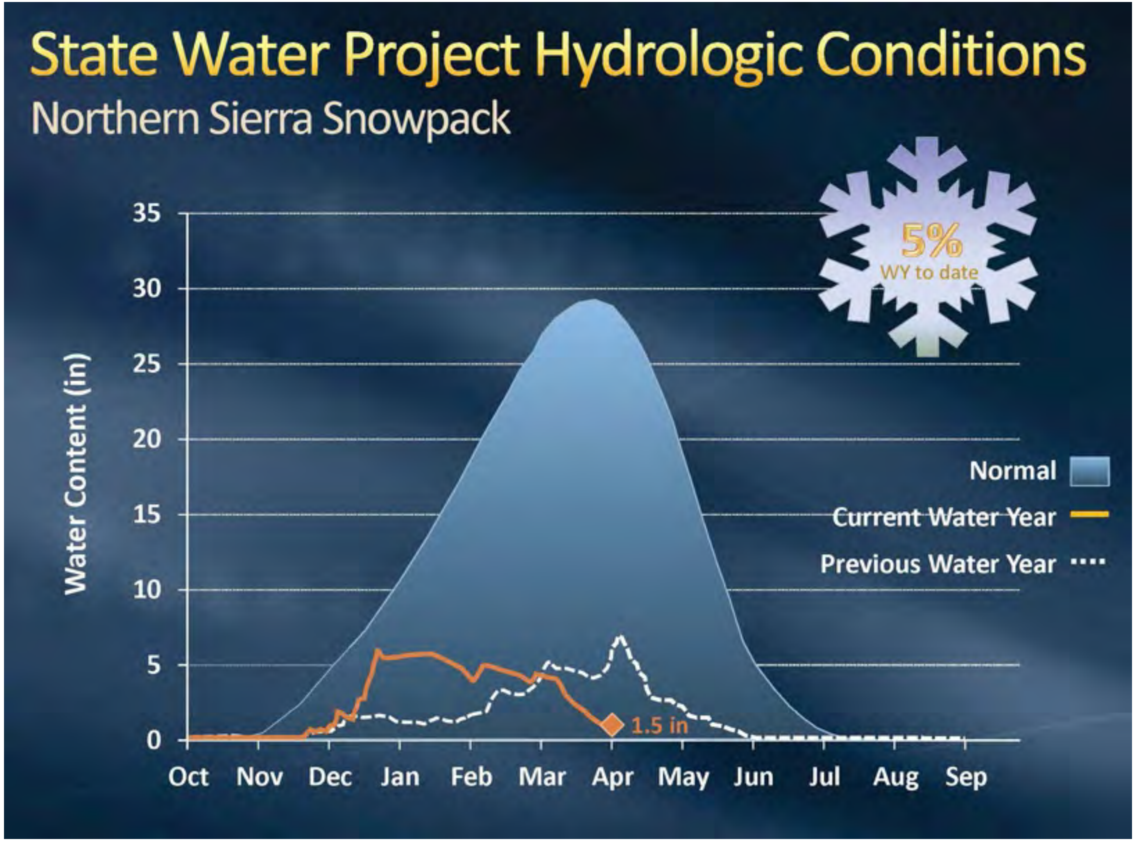
2014 State Water Project Allocation

5% - lowest

2014 Temps

Record high temperatures

Unprecedented Conditions



Extraordinary Actions

- April 1, 2015
- Lowest snowpack ever recorded
- Executive Order
- Reduce Urban Water use 25%

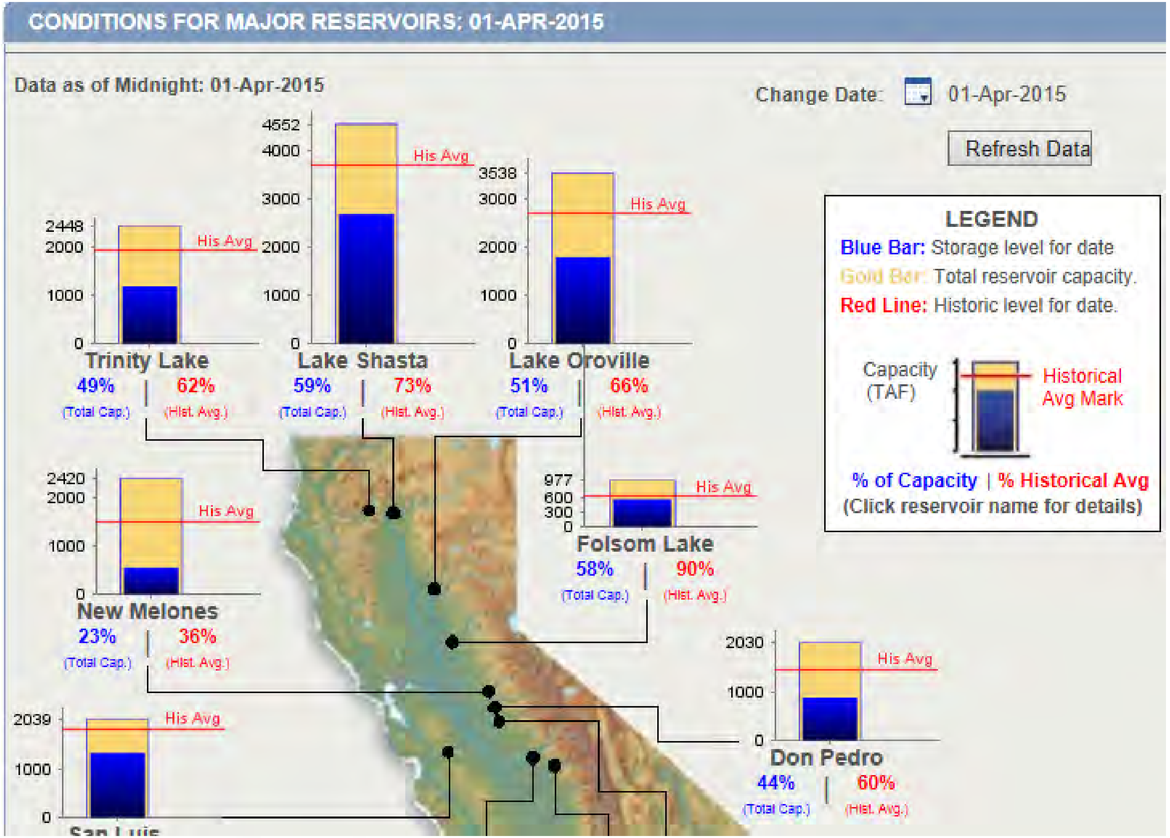
SWRCB End-user requirements

- No landscape runoff
- Do not wash down sidewalks, driveways, etc.
- Decorative fountains must recirculate
- Do not irrigate in rain or within 48 hours following
- Median irrigation of turf using recycled or nonpotable only
- Landscape requirements for new construction
- Ask for drinking water at a restaurant
- Hospitality industry – information about linen washing

SWRCB Mandatory Actions by Water Suppliers

- Notify customers of known leaks
- Report monthly production information to State Board
- Reduce potable urban 8-36 percent relative to 2013
- Reduction effective June 1, 2015
- Reductions measured monthly (15th of following month)
- Reductions assessed by State Board on cumulative basis

Goal: Save Available Supplies

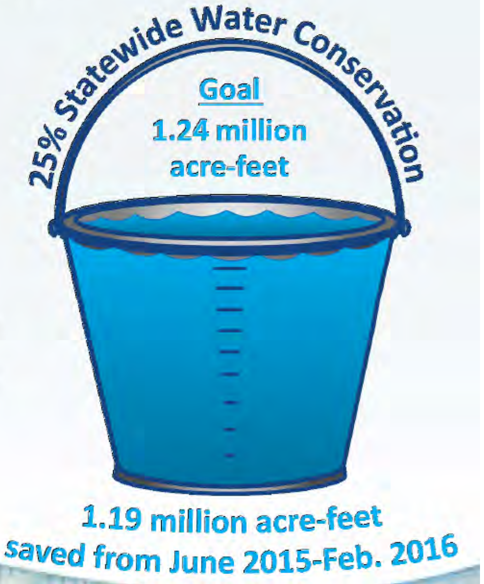


Californians Stepped Up!

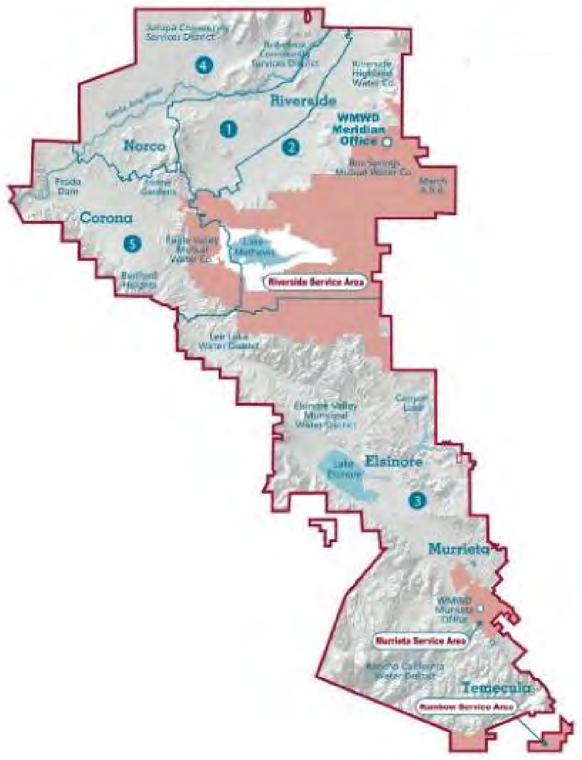
Statewide Cumulative Savings

(June 2015 – February 2016)

- 1,186,966 acre-feet (386.8 billion gallons) of water saved
- This is 96% of savings goal
- Savings is enough to provide 5.9 million Californians (15% of state population) with water for one year



Western Municipal Water District



- *527 square miles of western Riverside County*
- *Population of nearly 1 million…*
  1.5 million by 2030
- *25,000 retail customers*
- *13 retail agencies*
- *Metropolitan Water District member agency*

Western's plans for our communities' future include local supply development and water use efficiency.

Planning for Our Communities' Future

Local supply development:

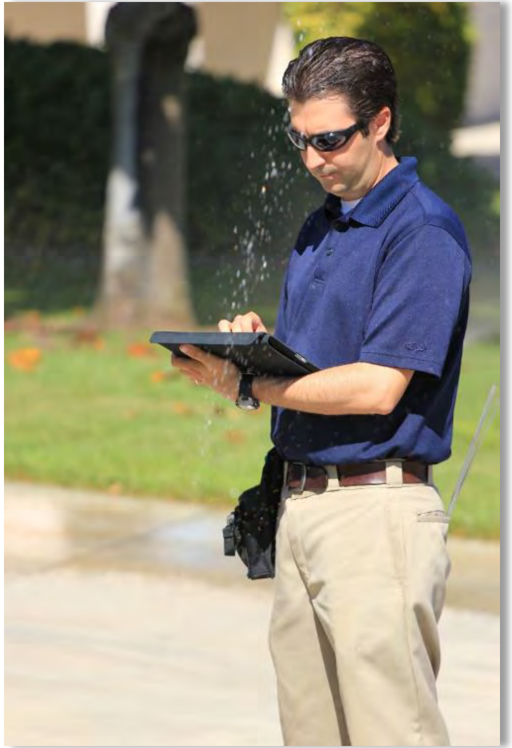
- Groundwater clean up and desalination facilities
- Groundwater basin recharge
- Expansion of recycled water
- Conjunctive use partnerships
- Stormwater capture

Planning for Our Communities' Future

Water Use Efficiency Master Plan 2008

- Allocation-based Rate Structure
- Education & Workshops
- Customer Support
- Incentives & Free Stuff

Customer support and incentives



Western offers free landscape efficiency evaluations to assist commercial and residential customers.

- Prioritizes repairs and provides photos of problem areas
- Funnels water users to other support programs

Customer support and incentives

Premium rebates for select devices:

- Smart Controllers $300

FreeSprinklerNozzles.com

Turf Replacement Program:

- 6 million square-feet replaced in ’15
- $12 million ($2/sqft rebate)

Education and Workshops

Master Gardener Partnership

- Workshops
- Workdays
- Plant Sales
- Expert Expo
- Garden Docents

Education and Workshops

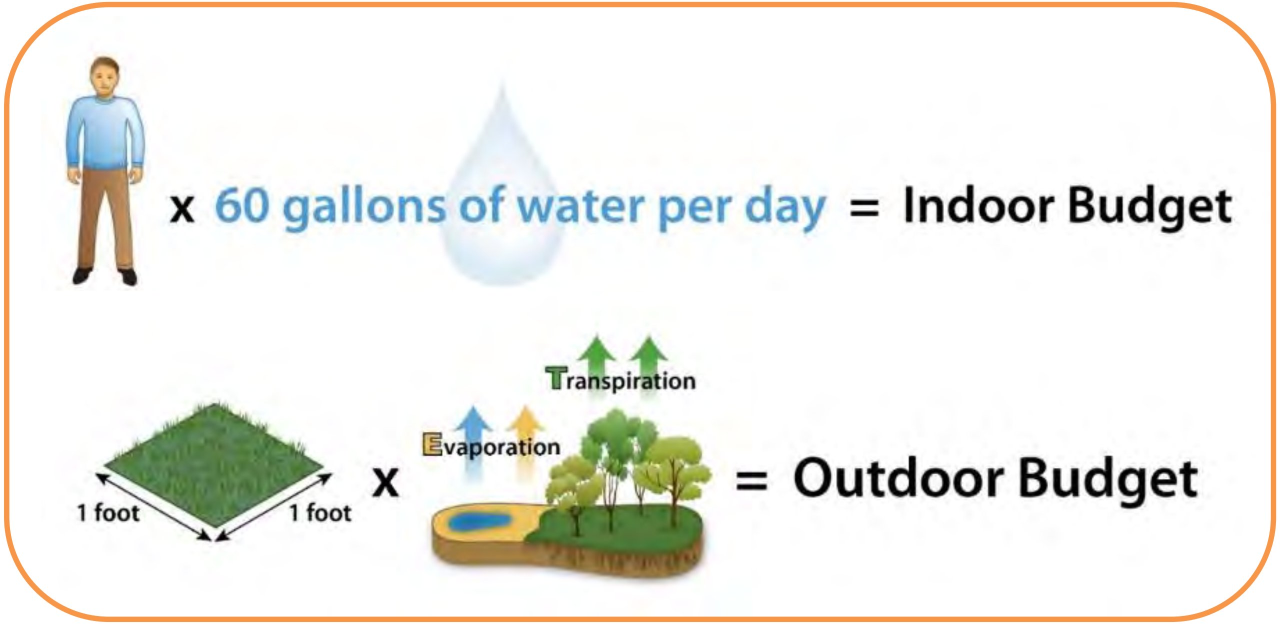
Water Saving Garden Friendly Partnership

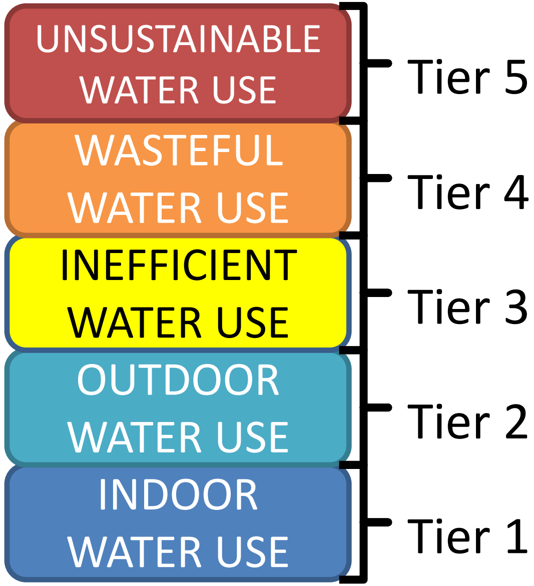
- Western partners with local agencies to provide information and choices on water-wise plants watersavinggardenfriendly.com

Regional Water-wise Landscape Contest

- Western sponsors a contest every two years open to residents inlandempirelandscapecontest.com

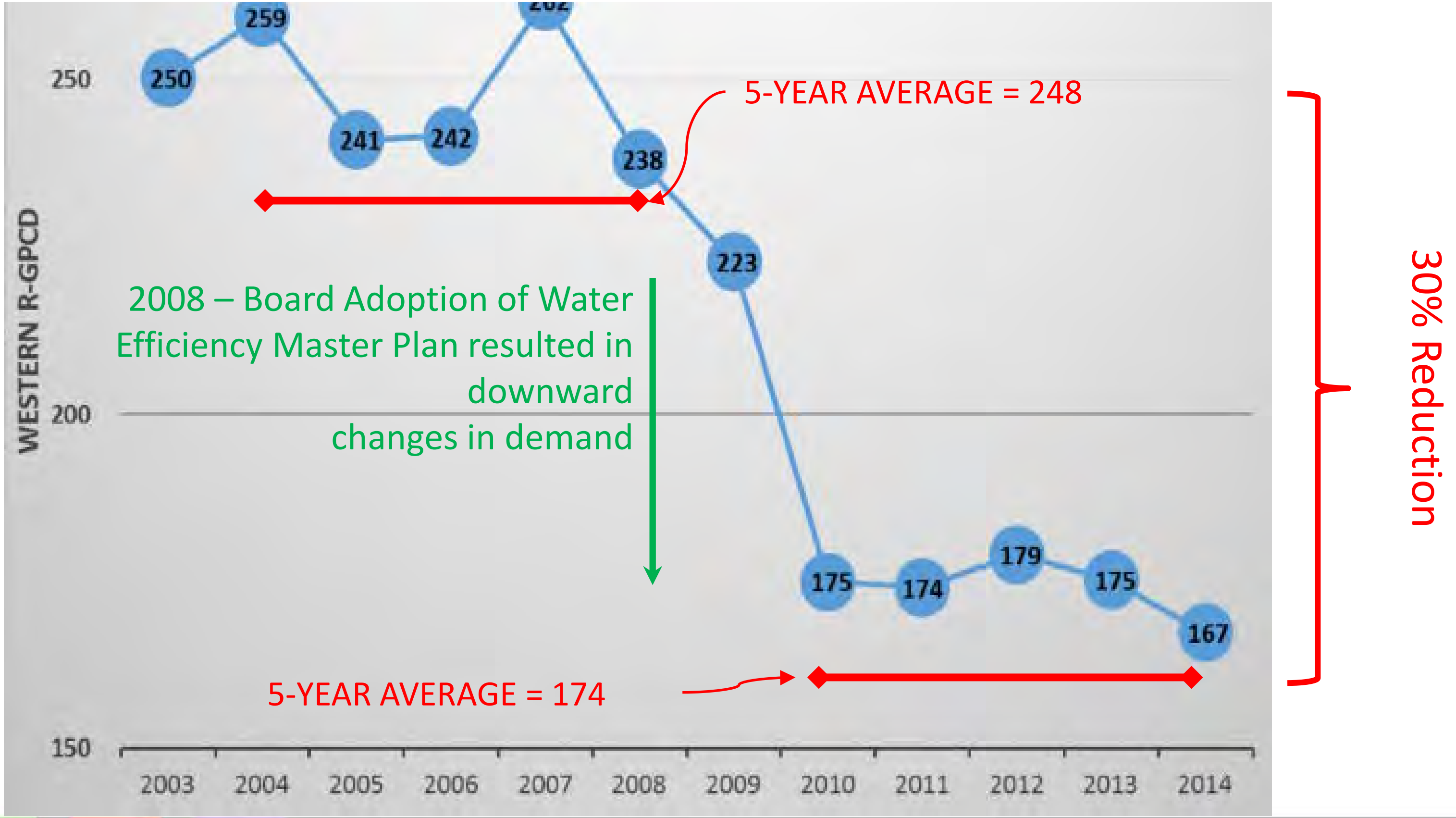
Rate Structure: Residential





Tier pricing is based on the cost of service at each level of water use.

Customers Embracing Efficiency



Reducing Water Budgets

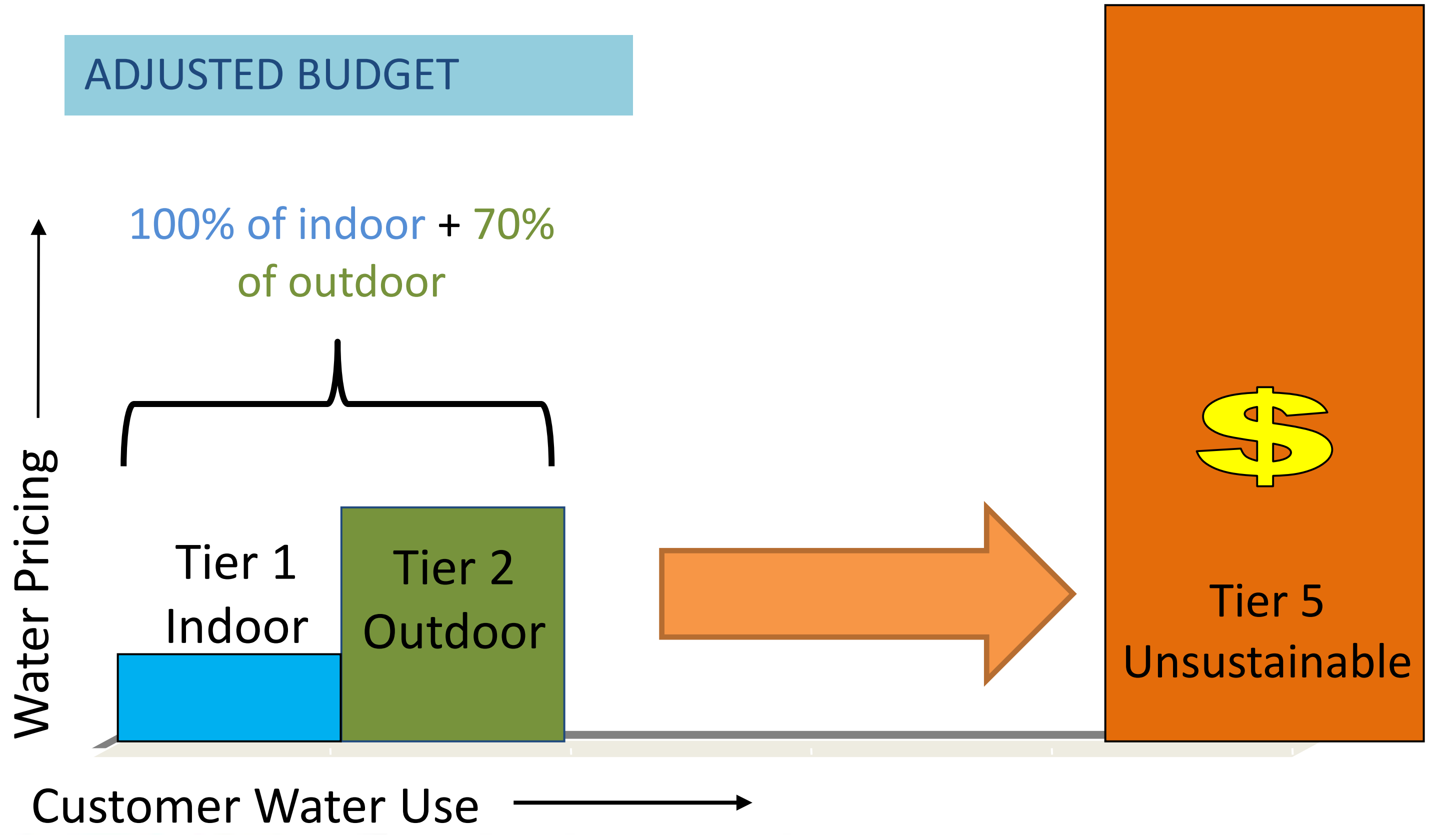
(a simplified view <u>after</u> the mandated 32% reduction)

X

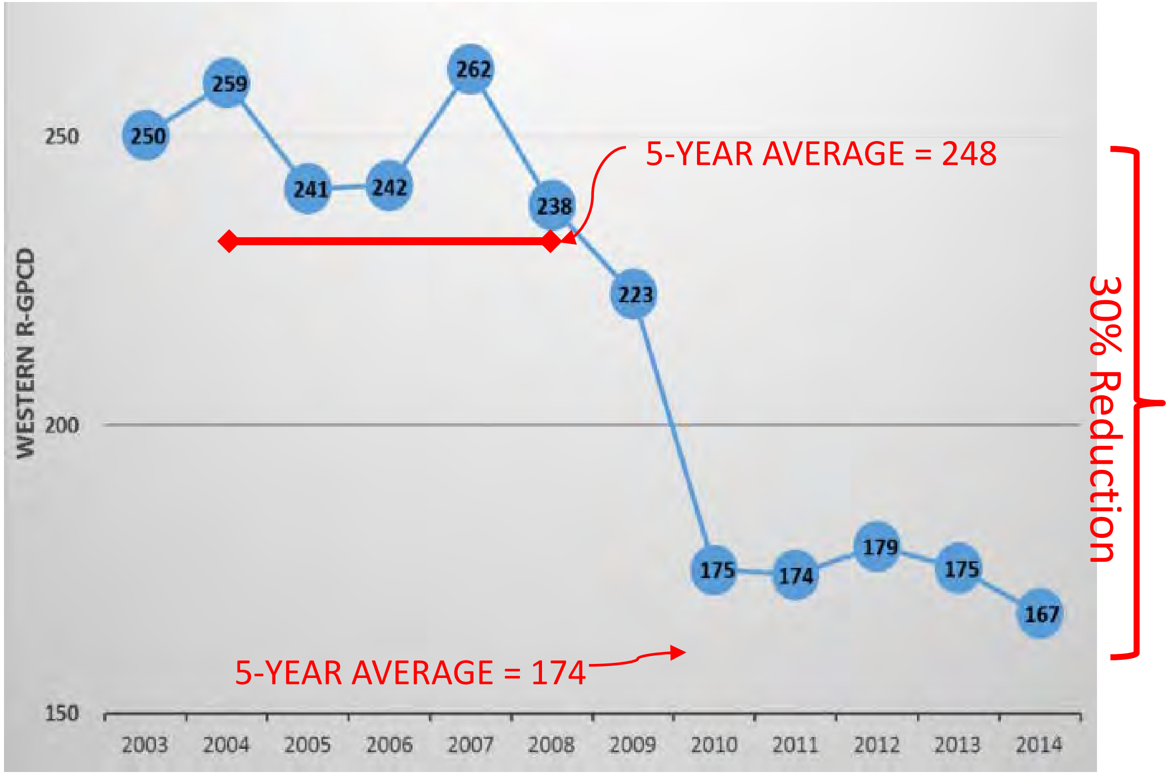
=

70% Outdoor Allocation

Drought Pricing

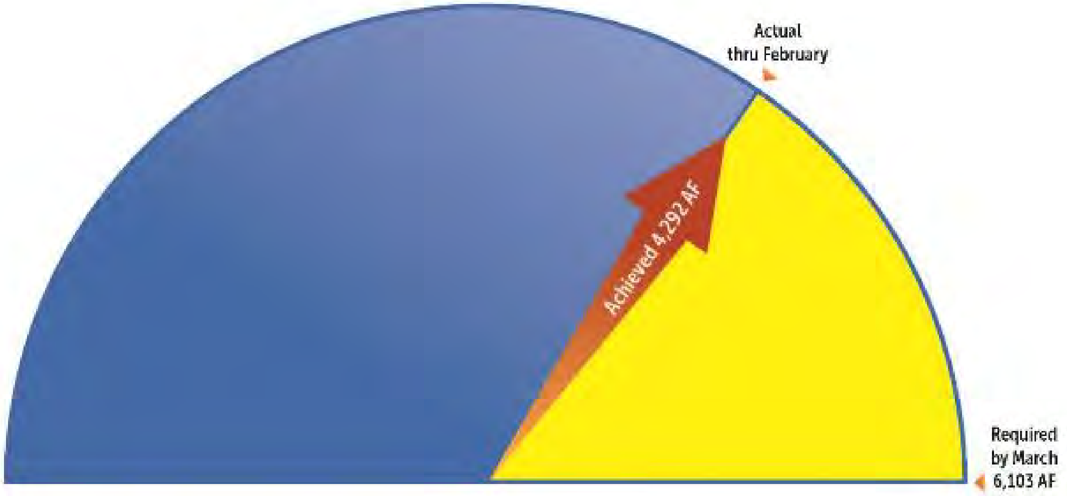


Methodology Matters



Applying a 32% Conservation Target to the 2013 Base Period resulted in a 62% community impact!

Cumulative Progress Report

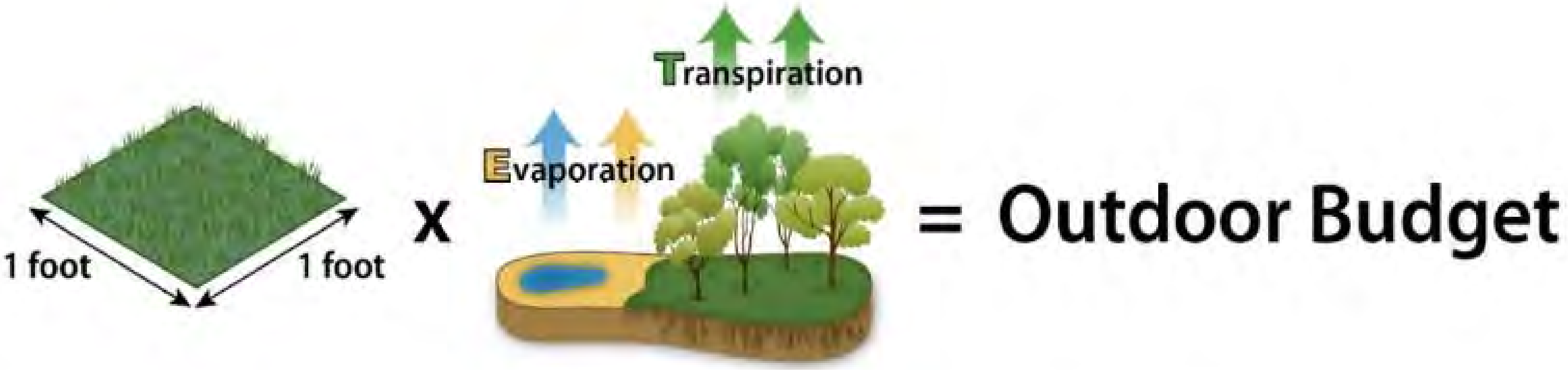


- Cumulative reduction through Feb 2016 was 23% percent
- Is Western a bad actor by missing the 32 percent target?

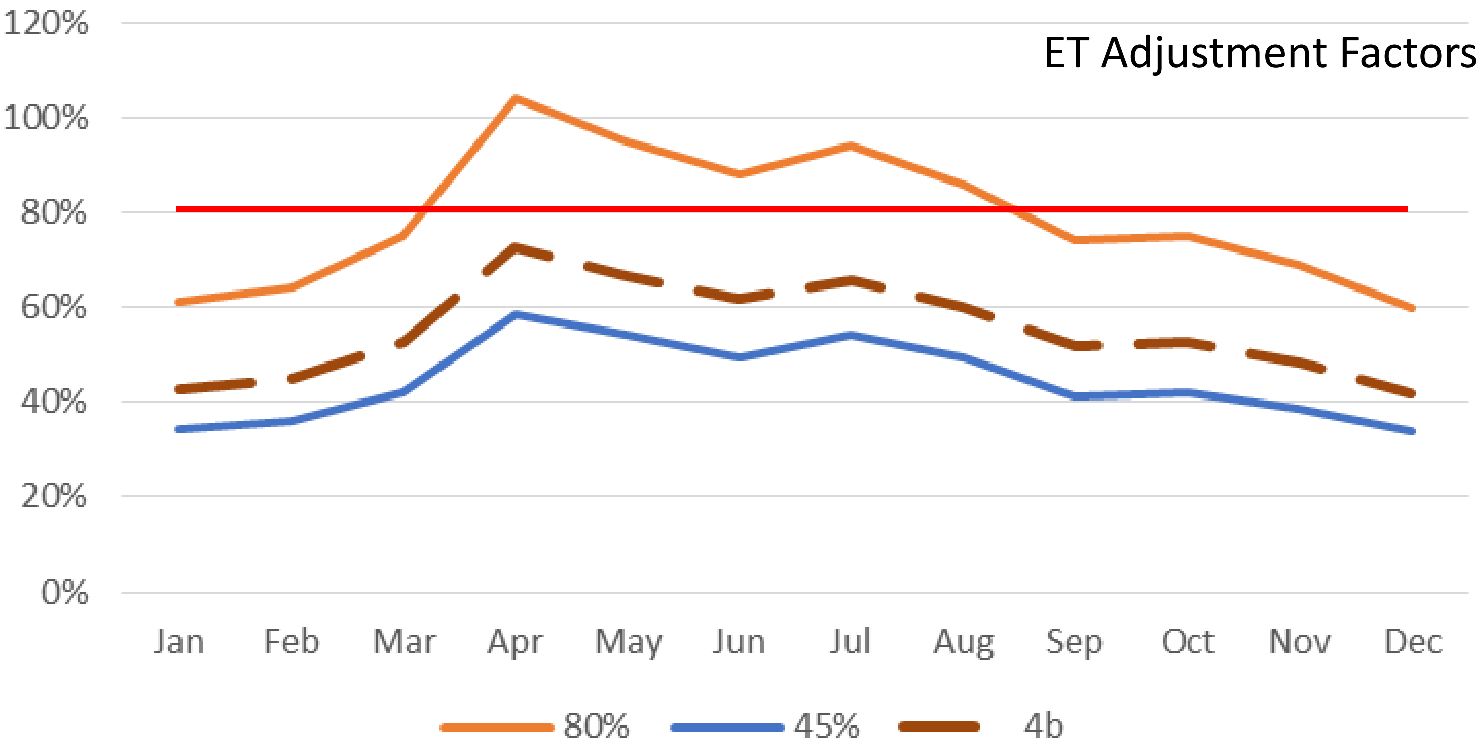
Considering reductions prior to the 2015 mandate,
Western's customers reduced by more than 50%.

Rate Structure: Landscape Budget

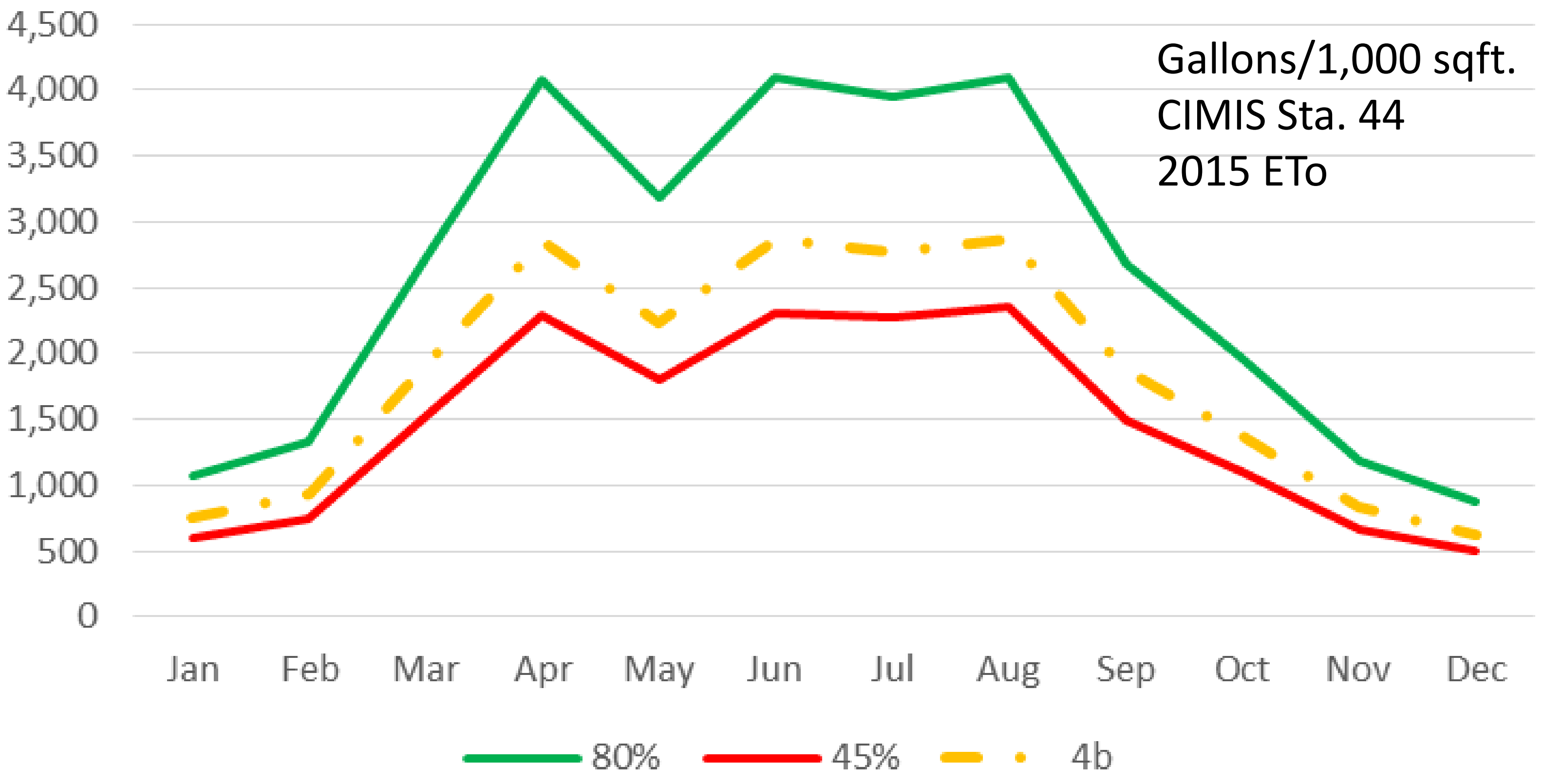
$$\text{OWB} = \left[\sum_{1}^{d} \left(\frac{\text{Landscape Area} * ET_0 * ETAF}{1200} + V_{\text{outdoor}} \right) \right] * DF_{\text{outdoor}}$$



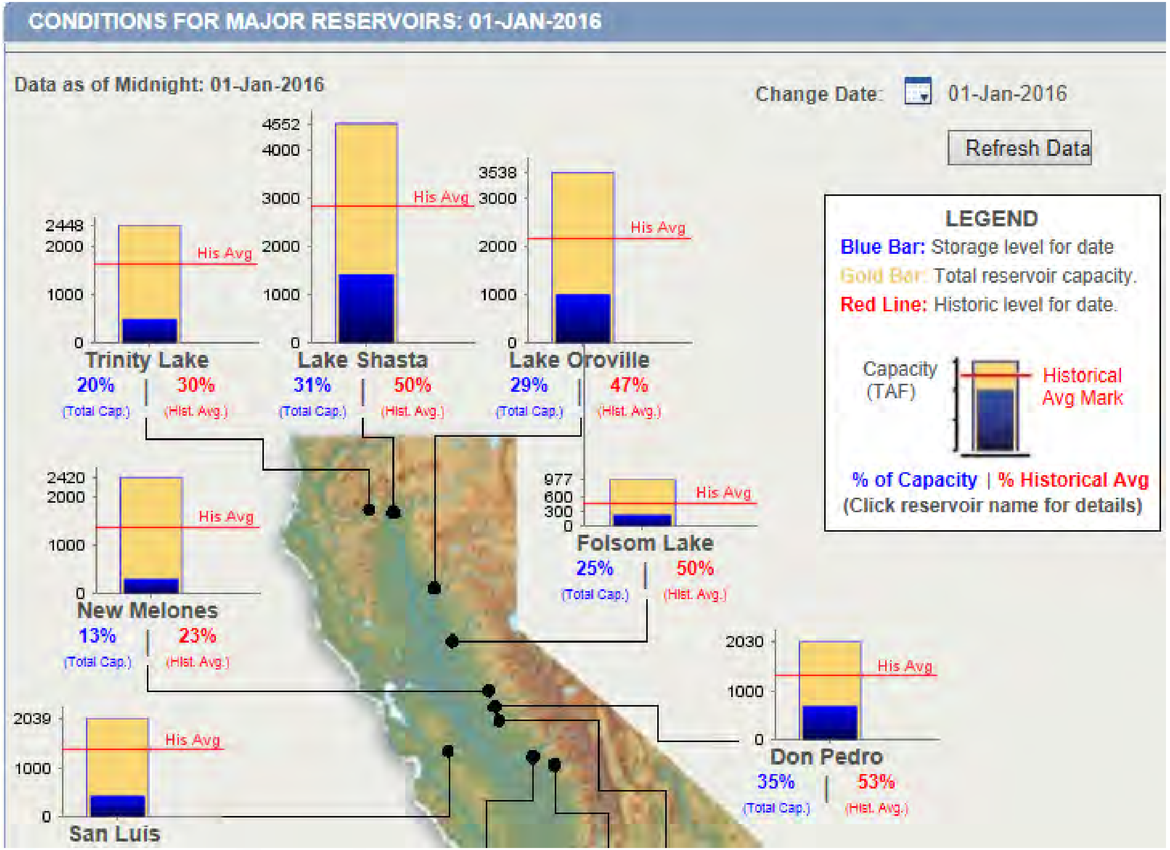
Rate Structure: Landscape Budget



Rate Structure: Landscape Budget



Changing Conditions



Changing Conditions

February 2016

"Still too early to declare emergency over"

SWP Allocation still 10% (12/1/15)

Developed a complex system of adjustments based on:

- Climate
- Population Growth
- Post 2013 Resilient Supplies
- 8% cap

Changing Conditions

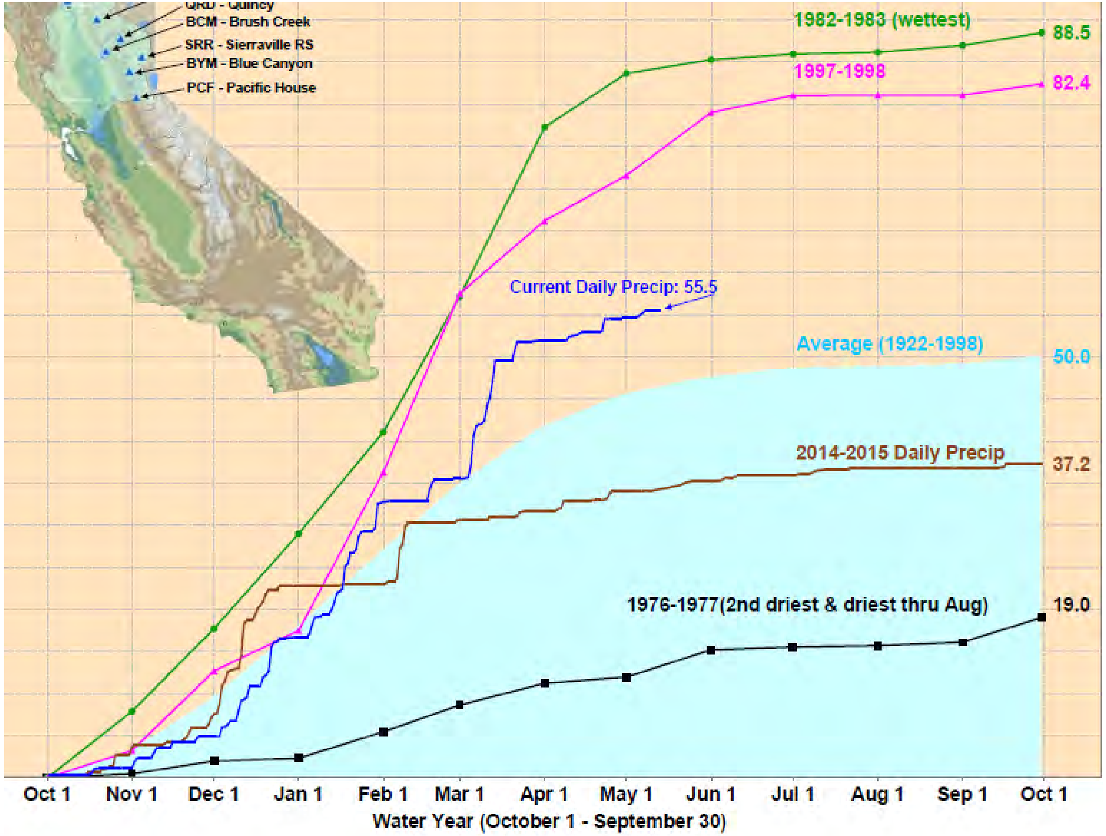
April 1, 2016 - Cumulative Northern Sierra Precip. at 124% of average

April 1, 2016 - Northern Sierra Snowpack at 94% of average

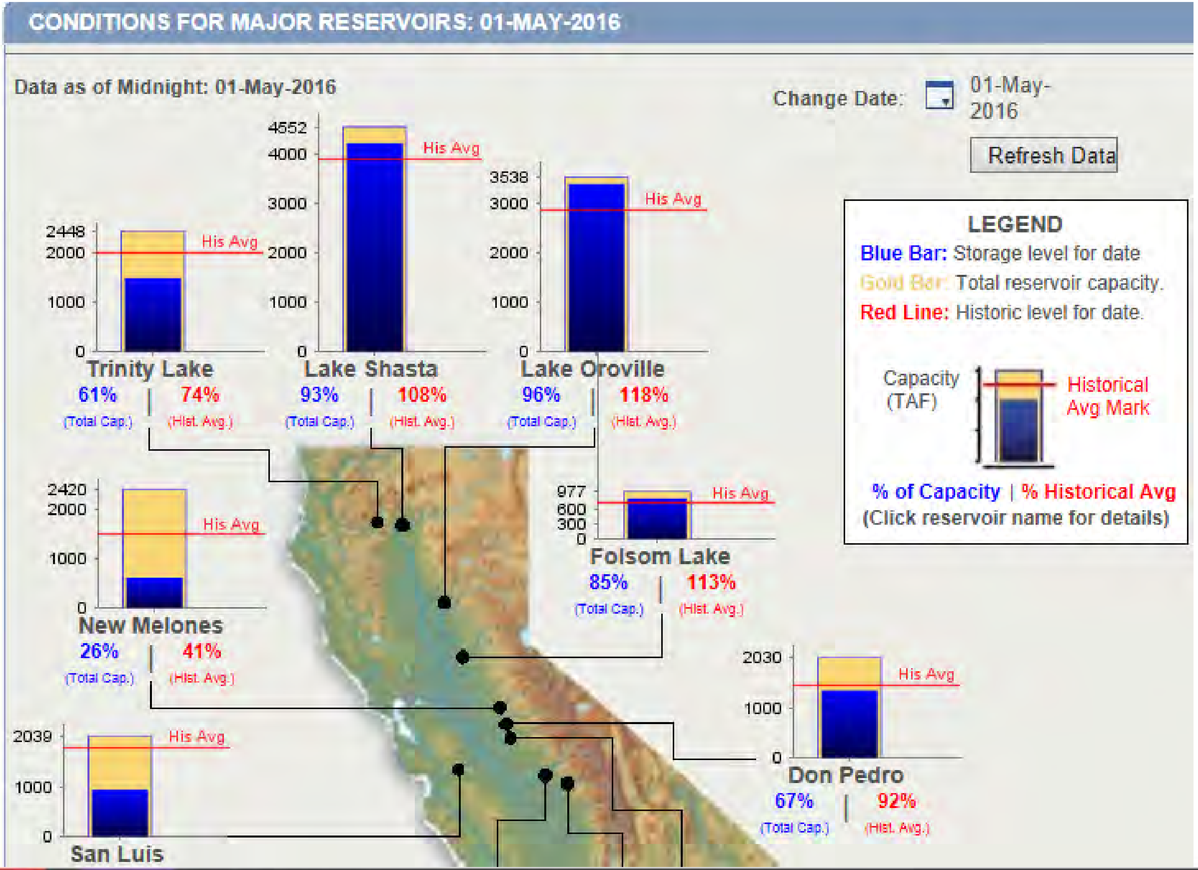
Flood control releases occurring at key reservoirs

"It doesn't feel like an emergency anymore."

Changing Conditions



Changing Conditions



Next Steps

Executive Order by the Governor

SWRCB staff proposal (Many 18, 2016)

Retain many of the end user prohibitions and supplier reporting

Suppliers self-certify that they have enough water to meet demands in 2019 using the last three years in the calculation

Long-term Water Efficiency in California

California Urban Water Policy should:

- Achieve high levels of local efficiency by:
  - Encouraging investments in local water supply development and demand management programs;
  - Establishing a reasonably defined bar for residential and landscape water use; and,
  - Incentivizing California's end users to replace non-water conserving devices and landscapes.

Long-term Water Efficiency in California

California Urban Water Efficiency Policy should:

- Incorporate considerations for diversity in supply availability, supply portfolios, regional climate, population trends, housing density and past conservation activities; and,
- Require common-sense prohibitions on end user water waste activities such as irrigation over spray and run off into curbs and gutters; and,
- Utilize water use standards developed by subject matter experts.

Long-term Water Efficiency in California

California Urban Water Efficiency Policy should <u>not</u>:

- Apply mandates without considering water supply availability at the local level;
- Assume that high water use is the same as inefficient water use;
- Apply different standards to a population based on geographic location; or
- Disadvantage one region of the State over another

Thank you!

MWELO Update & Panel Discussion

Joe Berg, Peter Estournes & Jon Wreschinsky

Dr. Stuart Styles
Brianna Greenlaw
Cody Trueblood

Ernie Righetti Memorial Weather Station

ITRC
moving water in new directions

Irrigation Training & Research Center (ITRC)
California Polytechnic State University (Cal Poly)
San Luis Obispo, CA 93407-0730

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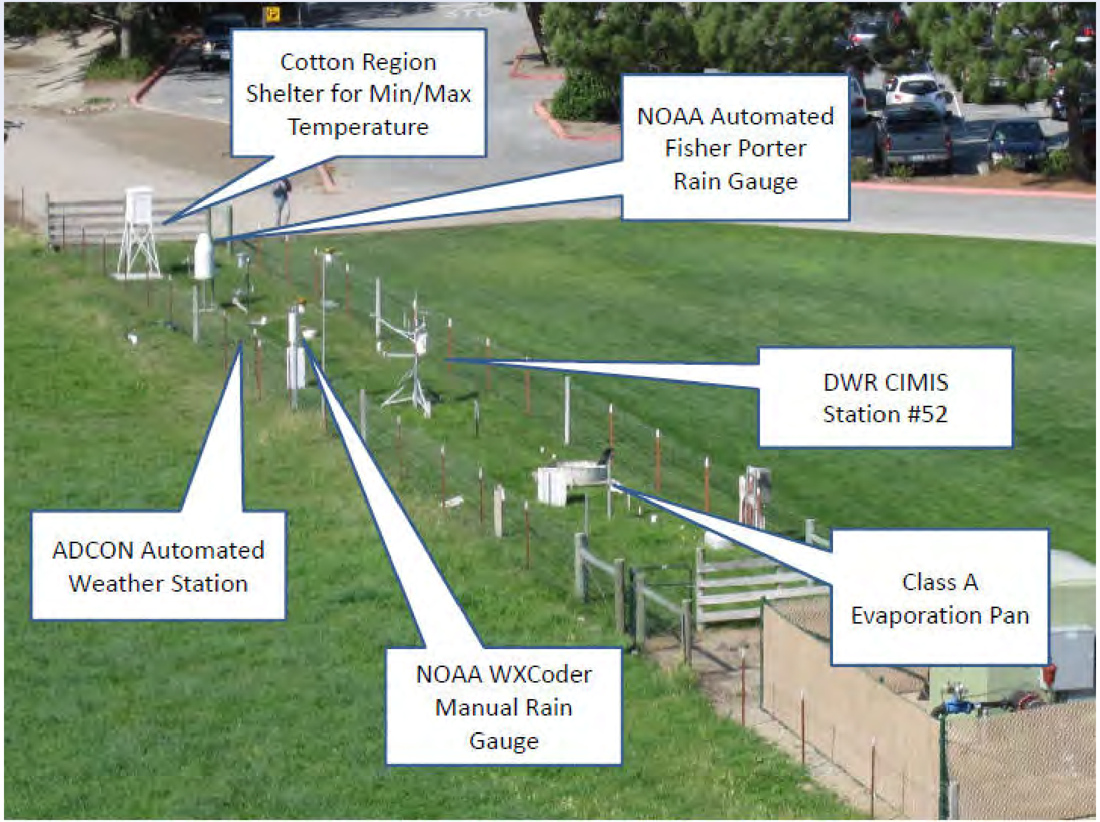
Consists of:



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DWR CIMIS Station #52

California Irrigation Management Information System is an automated weather system which automatically records and sends hourly data to the local DWR office.

It measures:

- Evapotranspiration
- Precipitation
- Solar radiation
- Vapor pressure
- Air temperatures
- Relative humidity
- Dew point
- Wind speed
- Soil temperature

NOAA WXCoder Manual Rain Gauge

Daily precipitation is recorded every day and sent to the local National Oceanic Atmosphere Administration office.

Data can be accessed at:
www.itrc.org/databases/precip

Adcon Automated Weather Station

System automatically records and sends data to a server, which then puts real-time data on the internet.

Measures:

- Precipitation
- Temperature
- Relative Humidity

Data can be accessed at:

http://apro.mccrometer.net/secure/common/main.vm

Username: guest_ITRC

Password: ITRC

Fisher & Porter Rain Gauge

- This gauge weighs the precipitation it collects in a large metal bucket.
- Observer sends the monthly data to the local NOAA office.
- Designed to work in remote and harsh environments.

Cotton Region Shelter

- Max and min thermometers measure temperature extremes in a well-ventilated shelter.
- Observer records the data daily at 4 pm and sends to the local NOAA office.

Data can be accessed at:
www.itrc.org/databases/precip

2014-15 Quality Control Check

Primary Gauges

Summary of Rainfall Data at Cal Poly Stations (in inches)

Date		NOAA WX Coder Manual Gauge	NOAA Automated Fisher & Porter Gauge	ADCON Gauge used by NOAA	CIMIS Station 52 Automatic Gauge - 1
		[1]	[2]	[3]	[4]
Jul	2014	0.00	0.00	0.00	0.00
Aug	2014	0.00	0.00	0.00	0.00
Sep	2014	0.00	0.00	0.00	0.00
Oct	2014	0.00	0.00	0.02	0.94
Nov	2014	0.51	0.42	0.54	0.48
Dec	2014	5.89	5.73	5.69	5.49
Jan	2015	0.12	0.11	0.13	0.12
Feb	2015	2.31	2.55	2.32	2.33
Mar	2015	0.02	0.01	0.01	0.00
Apr	2015	1.49	1.69	1.36	1.30
May	2015	0.18	0.16	0.17	0.17
Jun	2015	0.00	0.00	0	0.02
Total		10.52	10.67	10.24	10.85

Sources:
1) Maintained by Dr. Stuart Styles - Cal Poly ITRC located at historical weather station for Cal Poly San Luis Obispo
2) Data from the NOAA automated gauge at IPF - https://ols.nndc.noaa.gov/sub-login.html -- hourly data (needs to be QC'd by NOAA)
3) Maintained by Dr. Stuart Styles - Cal Poly ITRC, http://demousa.adcon.com:9090
4) Collected by CIMIS through the Department of Water Resources - Station 52 - http://wwwcimis.water.ca.gov/cimis/frontDailyReport.do

2015-16 Quality Control Check

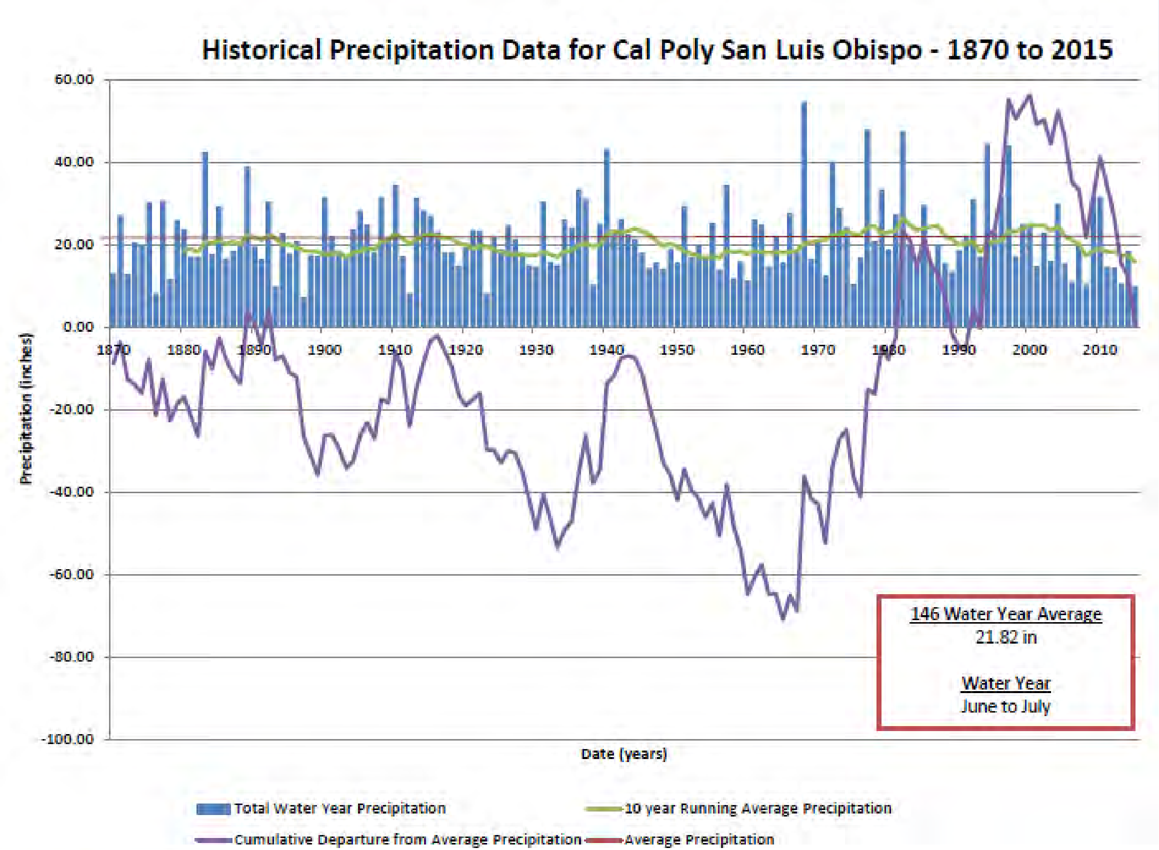
Primary Gauges

Summary of Rainfall Data at Cal Poly Stations (in inches)

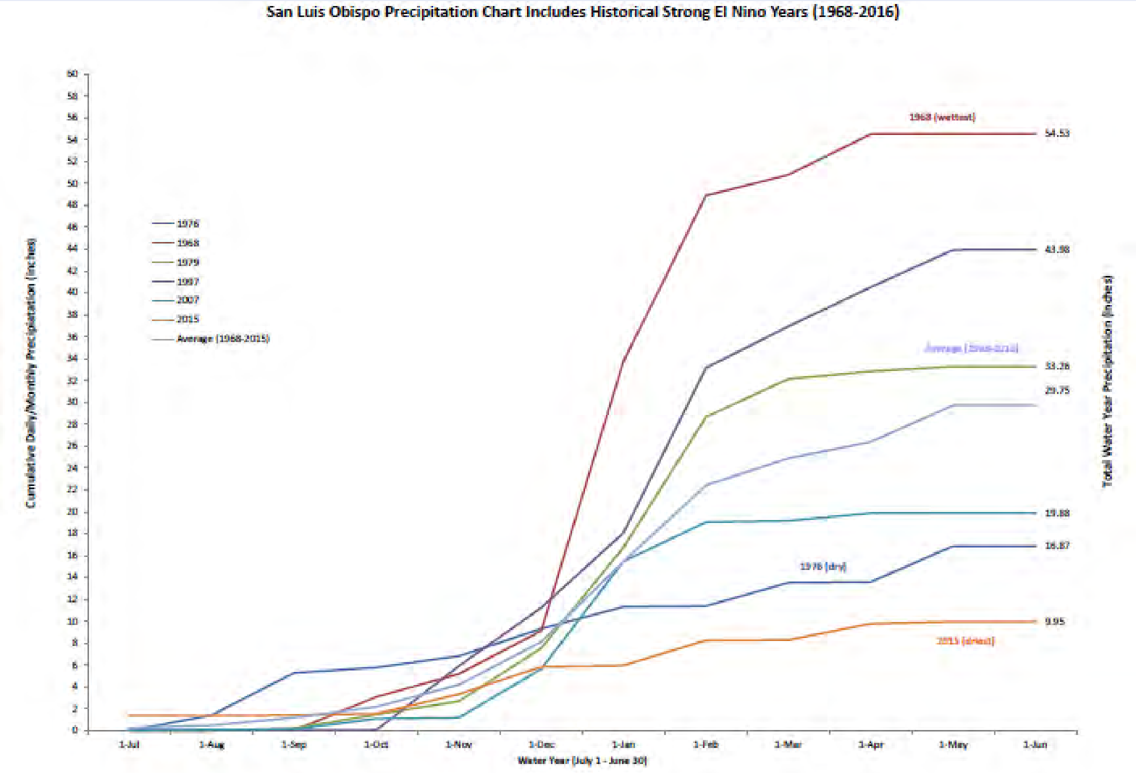
Date		NOAA WX Coder Manual Gauge	NOAA Automated Fisher & Porter Gauge	ADCON Gauge used by NOAA	CIMIS Station 52 Automatic Gauge - 1
		[1]	[2]	[3]	[4]
Jul	2015	1.37	1.30	1.32	1.30
Aug	2015	0.00	0.00	0.00	0.00
Sep	2015	0.05	0.05	0.00	0.02
Oct	2015	0.13	0.00	0.01	0.07
Nov	2015	1.78	1.45	2.24	1.61
Dec	2015	2.50	2.20	2.73	2.63
Jan	2016	6.85	4.48	6.63	6.18
Feb	2016	0.70	0.68	0.00	0.66
Mar	2016	5.84		6.05	5.18
Apr	2016	0.25		0.27	0.22
May	2016				
Jun	2016				
Total		19.47	10.16	19.25	17.87

Sources:
1) Maintained by Dr. Stuart Styles - Cal Poly ITRC located at historical weather station for Cal Poly San Luis Obispo
2) Data from the NOAA automated gauge at IPF - https://ols.nndc.noaa.gov/sub-login.html – hourly data (needs to be QC'd by NOAA)
3) Maintained by Dr. Stuart Styles - Cal Poly ITRC, htt://demousa.adcon.com:9090
4) Collected by CIMIS through the Department of Water Resources - Station 52 - http://wwwcimis.water.ca.gov/cimis/frontDailyReport.do

146-Year Graph



San Luis Obispo Precipitation Chart



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Any Questions?

Bartleson Ranch Irrigation Design

BioResource and Agricultural Engineering
BioResource and Agricultural Engineering Department
California Polytechnic State University
San Luis Obispo
2016

Summary

- Design Purpose
- Constraints
- Field Survey
- Field Layout
- Operation
- Critical Path
- IRRICAD
- Cost Analysis

Design Purpose

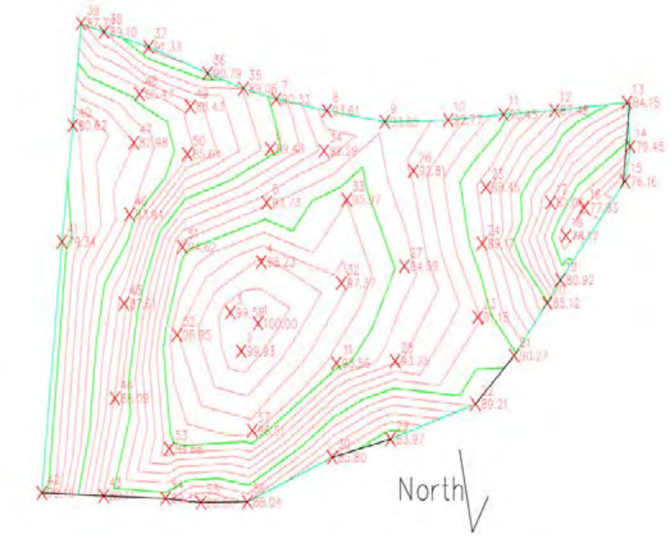
- Bartleson Ranch wants to convert a stumped Avocado orchard which has not been able to come back into production
- The design was created to replace an existing orchard of Avocados with Lemons
- The main change in the design is the tree spacing will change from 20’ x 40’ to 14’ x 20’

Constraint

- The irrigation design had multiple constraints
- 4 inch manifold in place
- Location of manifold at head of the field
- 6 inch mainline in place
- Preference to use single line hose with Netafim 1 GPH PC emitter
- Use of spaghetti hose with emitters
- 8 emitters used per tree

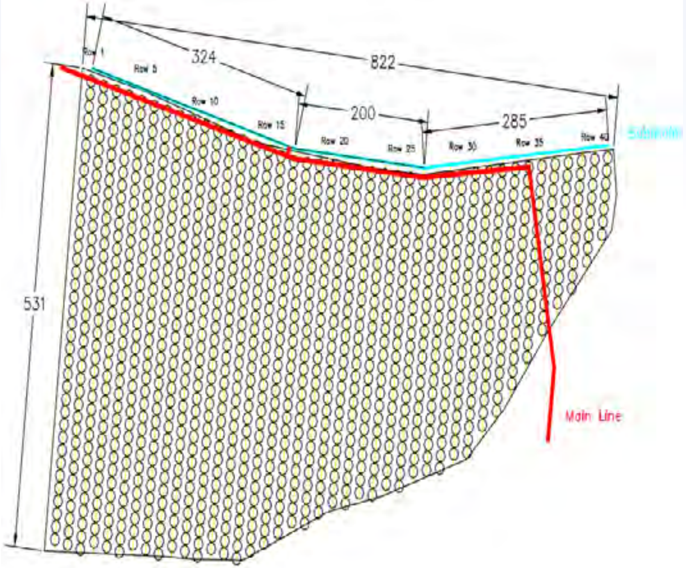
Field Survey

- Conducted with total station and data collector
- Measured elevation and position
- Determined field size of 7.6 acres
- Data derived in AutoCAD



Field Layout

- Tree row layout followed contours and existing pipeline
- Total of 41 rows
- Maximum row 37 trees
- Minimum row 7 trees
- Total number trees 1106



Operation

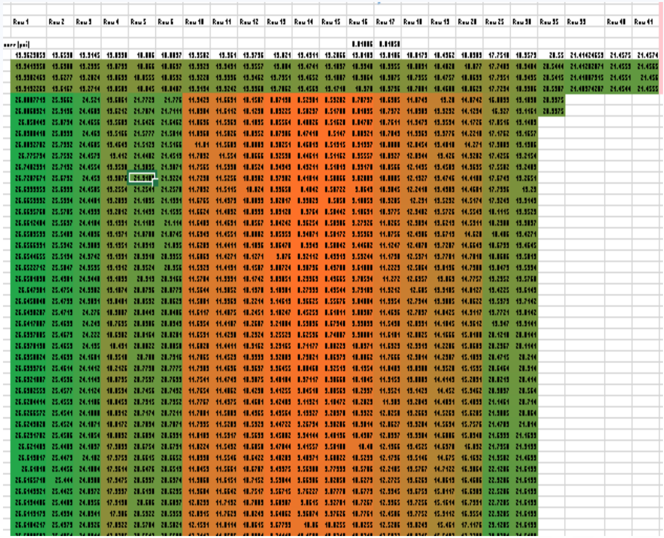
- Calculated total flow required 146 GPM
- Hours of operation determined to be 24 hours per week
  - Calculated to meet ET demand
  - Used ITRC ET value 4 in/month in zone 3 for Citrus

Critical Path

- Critical path determined by emitter with lowest operating pressure
- Emitter pressure range 7-45 psi
- Predicted path based on contour lines
- Calculated pressure at each emitter with assumed inlet pressure
- Found critical emitter value changed hose diameter to reduce losses
- Required inlet pressure d/s of valve 18 psi
  - Lowest emitter operating pressure 8 psi
  - Maximum emitter operating pressure 29 psi

Critical Path (cont)

- Critical Path (right)
- Emitter Pressure (left)



IRRICAD

- Irrigation Design Software Program
- Simple and easy to use
- Efficient
- Difficult to get exact library

IRRICAD Steps

- Import field layout (Google Earth)
- Convert elevations to contours
- Draw spray irrigation block
- Draw mainline
- Draw water source
- Analyze system
- Run report

Cost Analysis Comparison

Material List and Prices				
Length/Number	Description	Weight per foot	Unit Price	Total Price
	Submain and Manifold Materials			
810	4" CL 100 PIP pipe	0.993	$1.15	$924.98
1	4 inch valve		75	$75.00
	Lateral/Hose Material			
64	1.06 inch diameter hose (250ft)		$69.98	$4,478.72
8848	Netafim Emitter 01PC4 1 GPH		$0.23	$2,035.04

Total	$7,513.74

Zone Name : Area no. 1

Length/Number	Description	Unit Price	Price
811	4" Class 125 IPS SW PVC Pipe	1.20	974.11
15,526	1" Class 200 IPS SW PVC Pipe	0.16	2,483.65
965	1/2" Class 315 IPS SW PVC Pipe	0.10	96.51
1	4" Fresno Butterfly Lever OP	78.00	78.00
1	2" Nelson Solnoid ON/OFF Valve	345.00	345.00
8,873	1 GPH Dripper (Press Comp)	0.20	1,774.60
8,873	1G PH 360.0	0.00	0.00
		Total	5,751.88

Mainline (Main Water Supply - Supply no. 1)

Length/Number	Description	Unit Price	Price
11	6" Class 125 IPS SW PVC Pipe		
		Total	30.51

Total Cost	$5,782.39

Results and Recommendation

- IRRICAD performed as well as BRAE 414 irrigation design methods
- IRRICAD is simple to use although it is missing components

- It is recommended to install flush out manifolds on the design
- Manifold replacement, place manifold in center of field and reduce ends of the manifold to burn up friction and reduce costs

Questions?

Irrigation Training and Research Center

Center of Excellence

BioResource and Agricultural Engineering (BRAE) Department

ITRC

moving water in new directions

ITRC Bylaws

- Support the Cal Poly academic irrigation teaching program.
- Improve the irrigation/drainage conditions in California and the USA/World

Facilities

- Water Resources Facility
- John L. Merriam Irrigation Practices Field
- Office Building

Student Hours
Average over 11,000 per year

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California Agricultural Irrigation Dealers examining drip filter backflushing

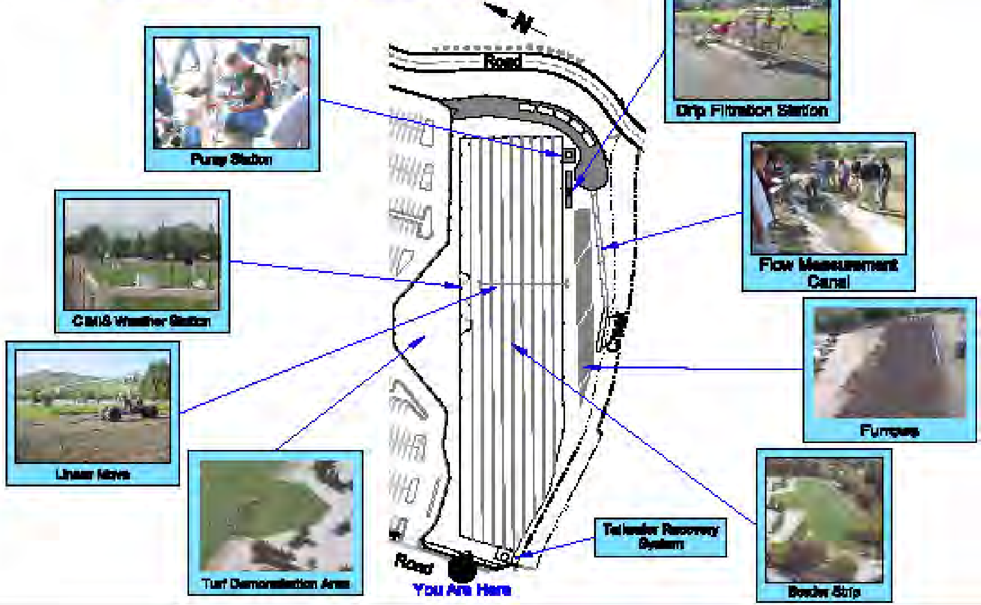
ITRC
moving water in new directions
Irrigation Training and Research Center

CAL POLY AGRICULTURE

BRAE

John L. Merriam
Irrigation Practices Field

Maintenance and upkeep provided by ITRC



Facilities & Features

CIMIS Weather Station	Filtration Systems
Flow Measurement Canal	Linear Move
Furrows	Border Strip
Pump Station	Drip Hose Equipment
Fertigation Equipment	Hand Move Sprinklers
Landscape Sprinklers	Soil Moisture Sensors

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Technical Areas by ITRC

- ✓ Innovative research
- ✓ Pragmatic training
- ✓ Cutting-edge technical support
- ✓ Supports Cal Poly BS and MS academic Irrigation & Drainage programs

- ✓ Irrigation district modernization
- ✓ On-farm irrigation
- ✓ Water balances
- ✓ Automation/SCADA
- ✓ Energy conservation
- ✓ Water conservation
- ✓ Flow Measurement
- ✓ Crop Water Consumption

Clients of ITRC

- ✓ Irrigation Districts (e.g. MET)
- ✓ Federal Water Agencies (e.g. USBR)
- ✓ Irrigation Dealers
- ✓ State Agencies (e.g. DWR)
- ✓ Growers
- ✓ Manufacturers

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ITRC Activities

Research and Testing – 25%

Training – 10%

Technical Assistance – 65%

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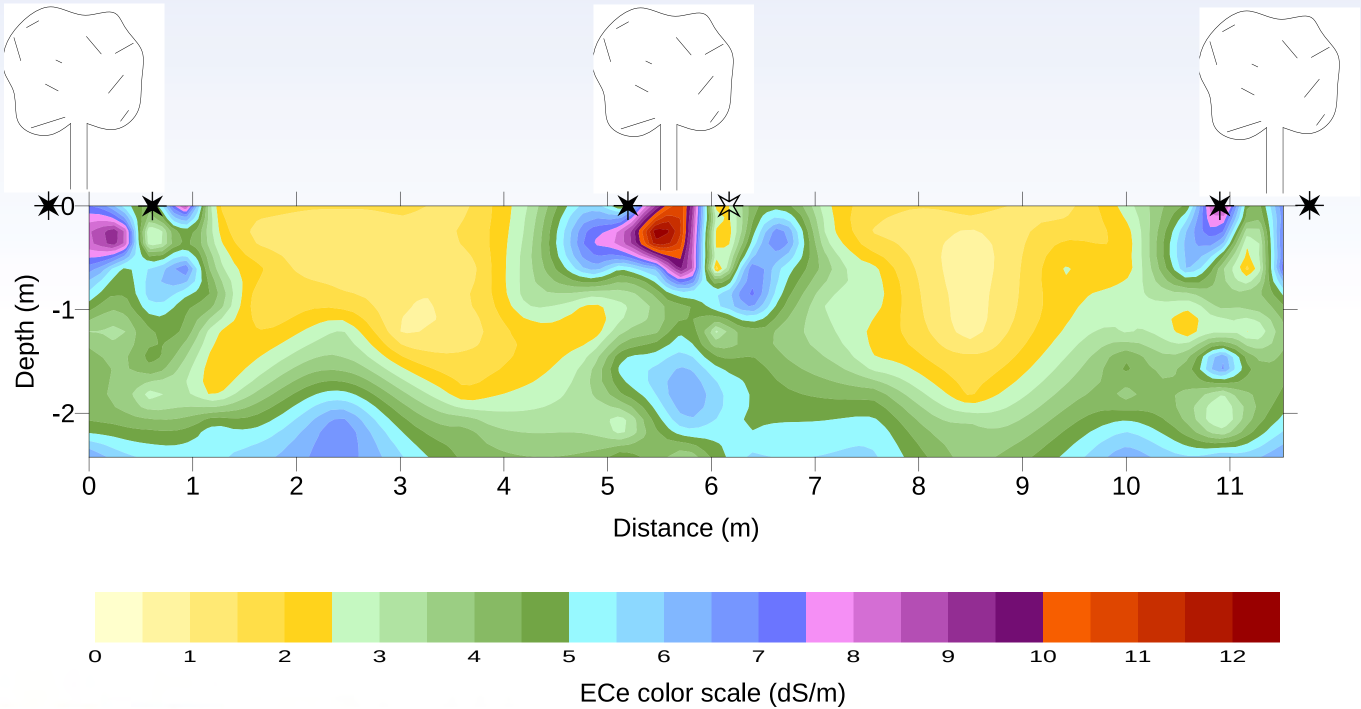
Example Research Projects:

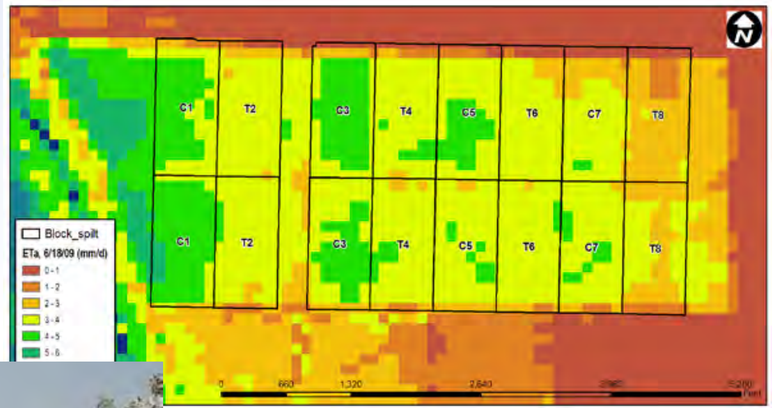
Salt accumulation under drip irrigation

Research – Long-term salinity buildup on the west side of the San Joaquin Valley

DRIP irrigation



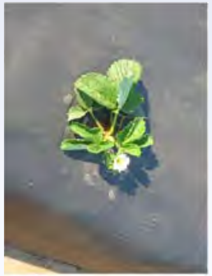
Research – ET reduction of pistachios with Kaolin spray



Research – Canal Seepage Reduction

Irrigation District	Compaction		Cost, $	L, ft	% Seepage Reduction
	Sides	Bottom			
Chowchilla WD	Y	N	4,845	4,240	**12***
James ID	Y	Y	3,240	1,010	**86**
James ID	Y	N	15,800	10,238	**31**
San Luis Canal Co.	Y	Y	1,945	1,730	**89**
San Luis Canal Co.	Y	Y – with ride-on	3,100	3,020	**90**

Research – Effects of sprinkler-only, partial sprinkler/drip, and drip-only on strawberry transplants



Objectives:

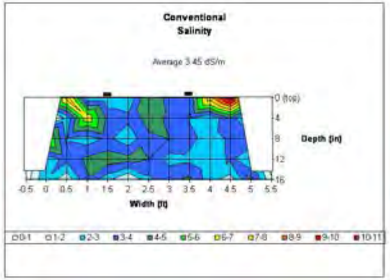
- Keep strawberry transplants healthy
- Switch to drip irrigation as early as possible

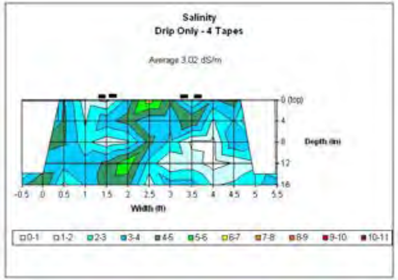
Main Issues:

- Soil salinity management
- **Uncollected sprinkler irrigation run-off**

Keys to Implementation:

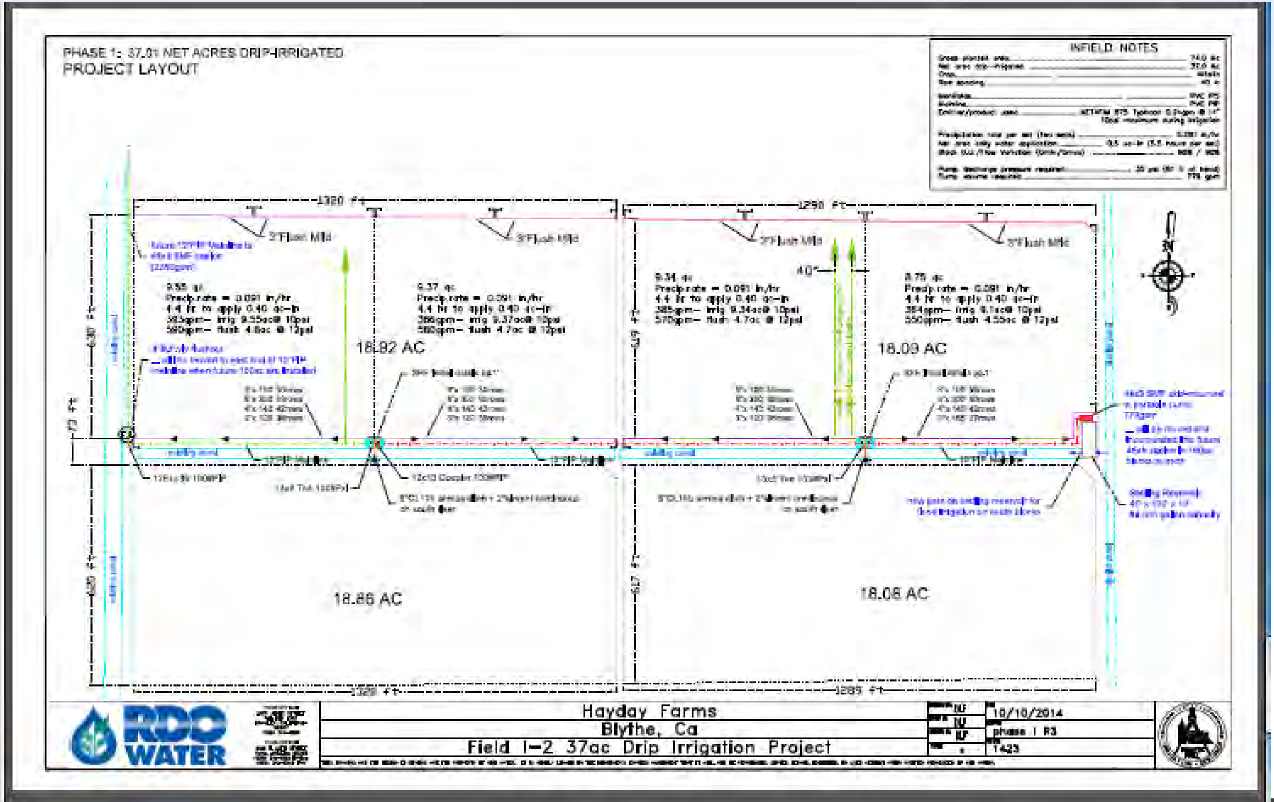
- Real-time soil salinity sensors
- **Correct drip irrigation design and management**
- **Demonstration-scale plots**





Funding by:
California Department of Food & Agriculture and
US Bureau of Reclamation – Mid Pacific Region

Evaluation of Drip on Alfalfa – HayDay Farms – Blythe, CA



Research – Magical Magnets from Australia

Magnets

- Increase infiltration and decrease deep percolation
- Reduce cardiac problems
- Reduce water usage by 30-50%
- Increase yields by 30-50%
- Improve gas mileage

- Truly amazing if you actually believe this stuff!


Hydraulics of Commercial Sand Media Filter Tanks used for Agricultural Drip Irrigation
http://www.itrc.org/reports/mediafilters.htm ITRC Report No. R 10-001

ITRC
moving water in new directions

Commercial Sand Media Filter Tank Criteria for Energy Efficiency
- Agricultural Drip Irrigation

Technical Report

September
2010

Research – Reducing energy requirements for drip irrigation

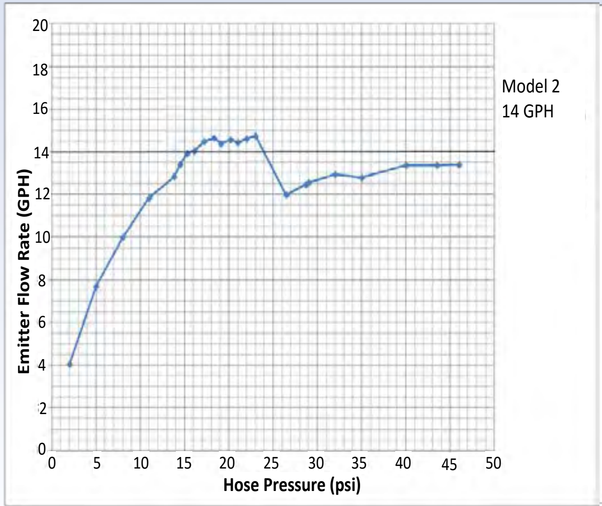
How about PC emitters?

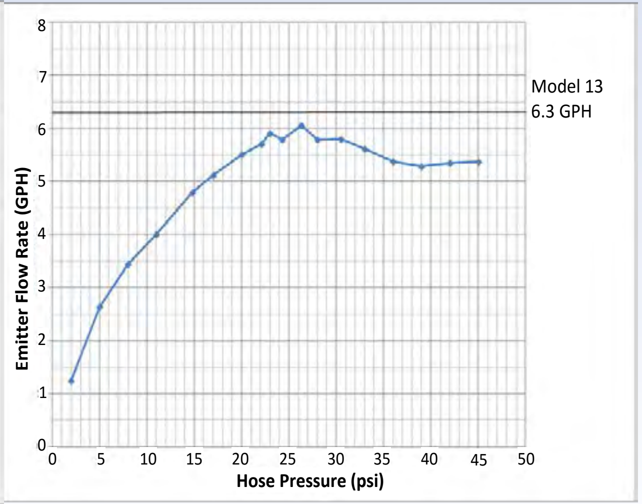
Most PC emitters today are high quality.

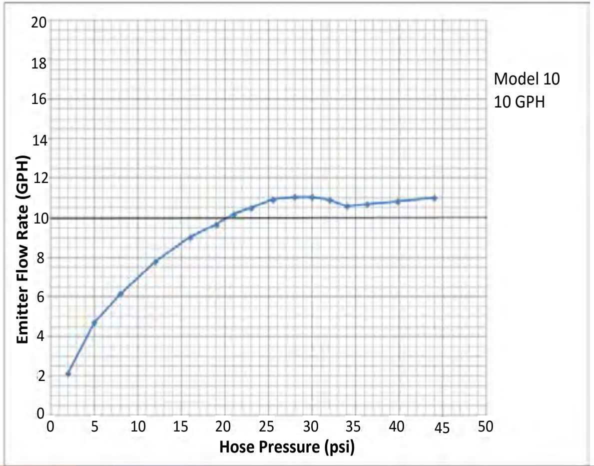
How about PC microsprayers?

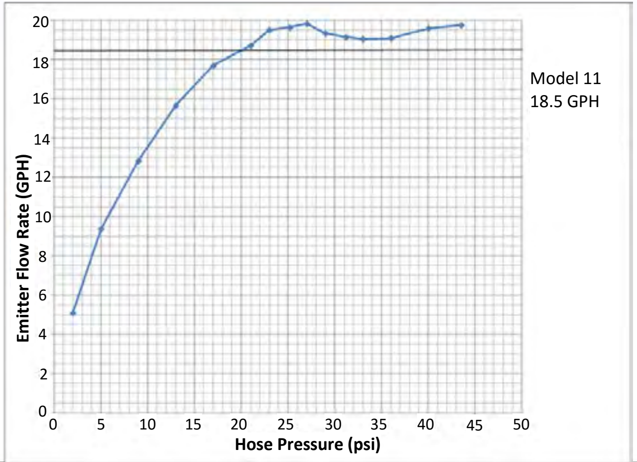
They aren’t nearly as good as the low flow PC emitters.

- High pressure requirements
- Varying flows with pressure changes
- Often the flow isn’t the nominal flow


Model 2
14 GPH
Emitter Flow Rate (GPH)
Hose Pressure (psi)
0
2
4
6
8
10
12
14
16
18
20
0 5 10 15 20 25 30 35 40 45 50


Model 13
6.3 GPH
Emitter Flow Rate (GPH)
Hose Pressure (psi)
0
1
2
3
4
5
6
7
8
0 5 10 15 20 25 30 35 40 45 50


Model 10
10 GPH
Emitter Flow Rate (GPH)
Hose Pressure (psi)
0
2
4
6
8
10
12
14
16
18
20
0 5 10 15 20 25 30 35 40 45 50


Model 11
18.5 GPH
Emitter Flow Rate (GPH)
Hose Pressure (psi)
0
2
4
6
8
10
12
14
16
18
20
0 5 10 15 20 25 30 35 40 45 50

ITRC Activities

Training – 10%


ITRC
IRRIGATION TRAINING AND RESEARCH CENTER
California Polytechnic State University
San Luis Obispo, CA 93407

Microirrigation for Landscape

August 28, 2003
Sponsored by: USBR, Mid-Pacific Region

Front row L-R: Wendy Hallinan (Sunraysia Institute of TAFE), Cathie Paré (City of Santa Barbara), Gary Imazumi (UC Berkeley), John Farinelli (Watson Ag Irrigation), Dilshod Kimsanov, Mark White (Placer County RCD), Garey Porter (Netafim USA), Bruce Winn (Hydratec), Dave Abrams (Agricultural Products).
2nd row L-R: Miguel Herrera (Fortier & Fortier), Bob Walker (Instructor, ITRC), Saifullo Nurov, Nematjon Azizov, Paul Marina (Netafim USA), Bob Broderson (Conejo Recreation & Park District), Nick Turner (Conejo Recreation & Park District), Rafael Battle (Rain Bird), Phil LeBlanc (Agricultural Products), Richard Orlando.

Training

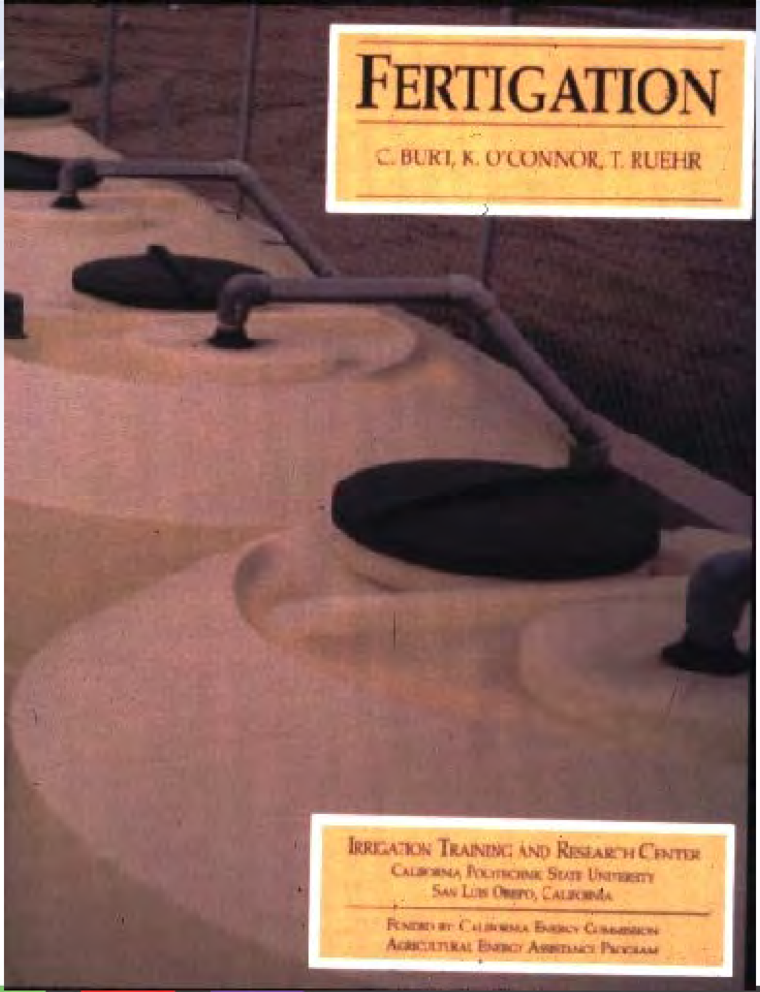
- Designer/Manager School of Irrigation
  - Summer
  - On-farm
  - Multiple, 1-3 day classes
- Irrigation District School of Irrigation
  - Winter
  - Flow measurement, canals, SCADA, etc.
- Many custom, on-site classes

Example

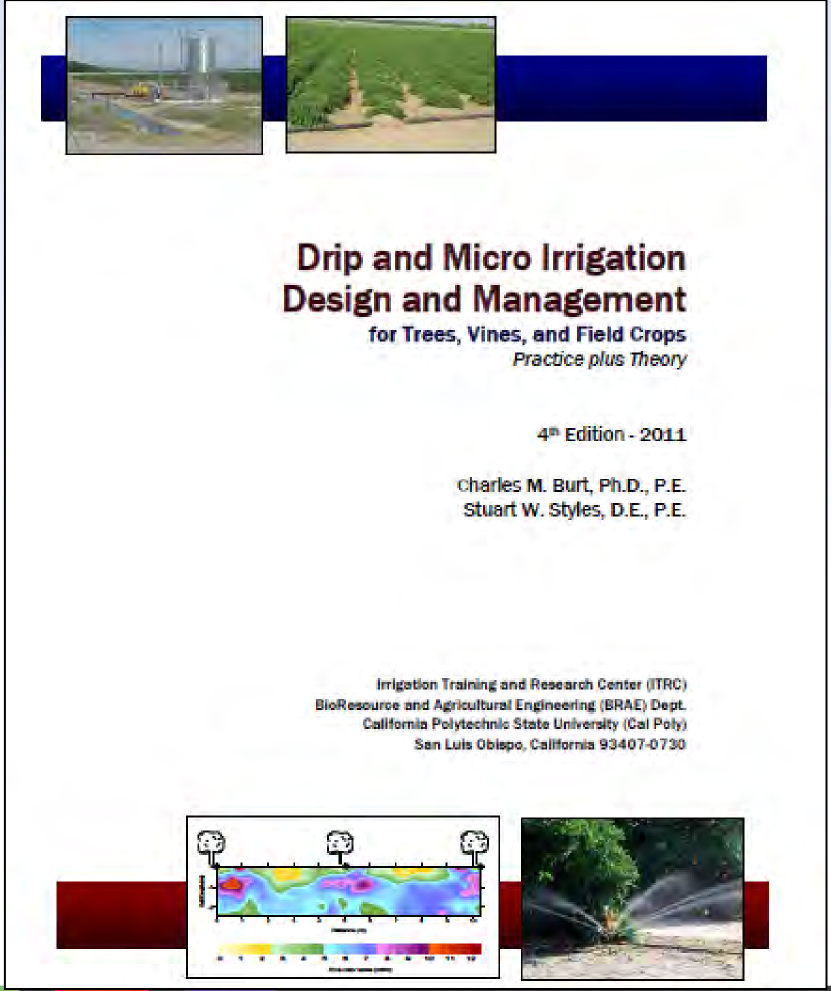
ITRC Designer/Manager School of Irrigation

2.5 weeks – every August

- Soil/Plant/Water
- Basic pipeline hyd.
- Basic pumps
- Advanced pumps
- Annual crop drip
- Fertigation
- Drip/micro design
- Drainage and scheduling
- Landscape spr. design
- Landscape water auditing
- Landscape drip design



We are rewriting this old but very popular publication



Drip and Micro Irrigation
Design and Management
for Trees, Vines, and Field Crops
Practice plus Theory

4th Edition - 2011

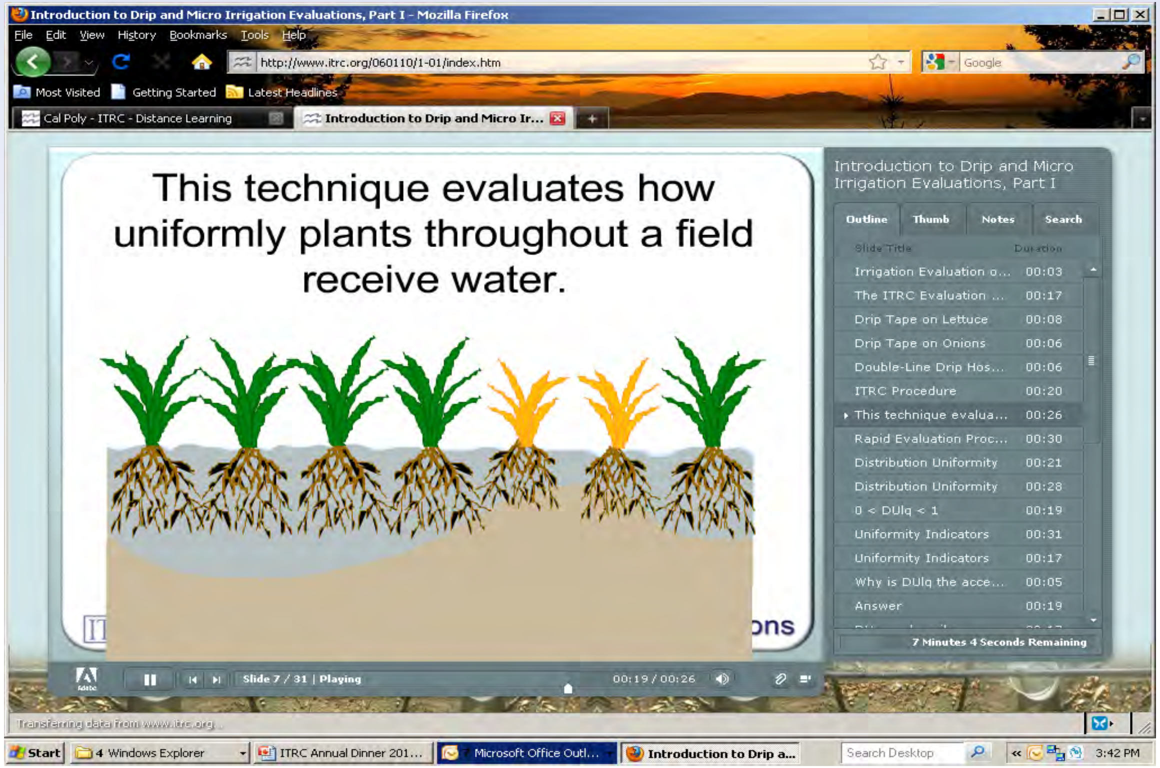
Charles M. Burt, Ph.D., P.E.
Stuart W. Styles, D.E., P.E.

Irrigation Training and Research Center (ITRC)
BioResource and Agricultural Engineering (BRAE) Dept.
California Polytechnic State University (Cal Poly)
San Luis Obispo, California 93407-0730

The book used by The Irrigation Association.

Essential
for training irrigation
designers in California.

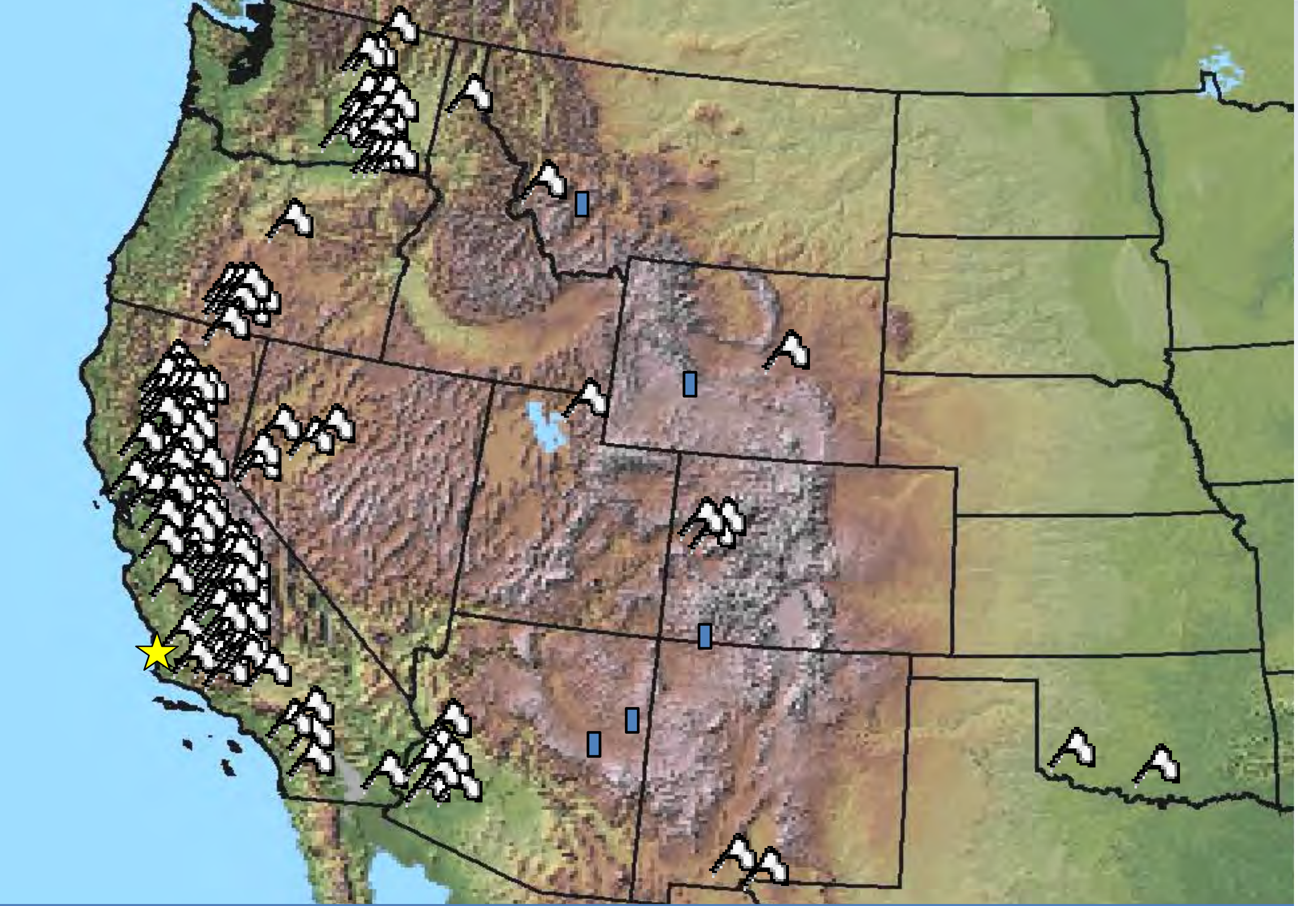
5th Edition out in June 2016



New web-based irrigation evaluation training modules

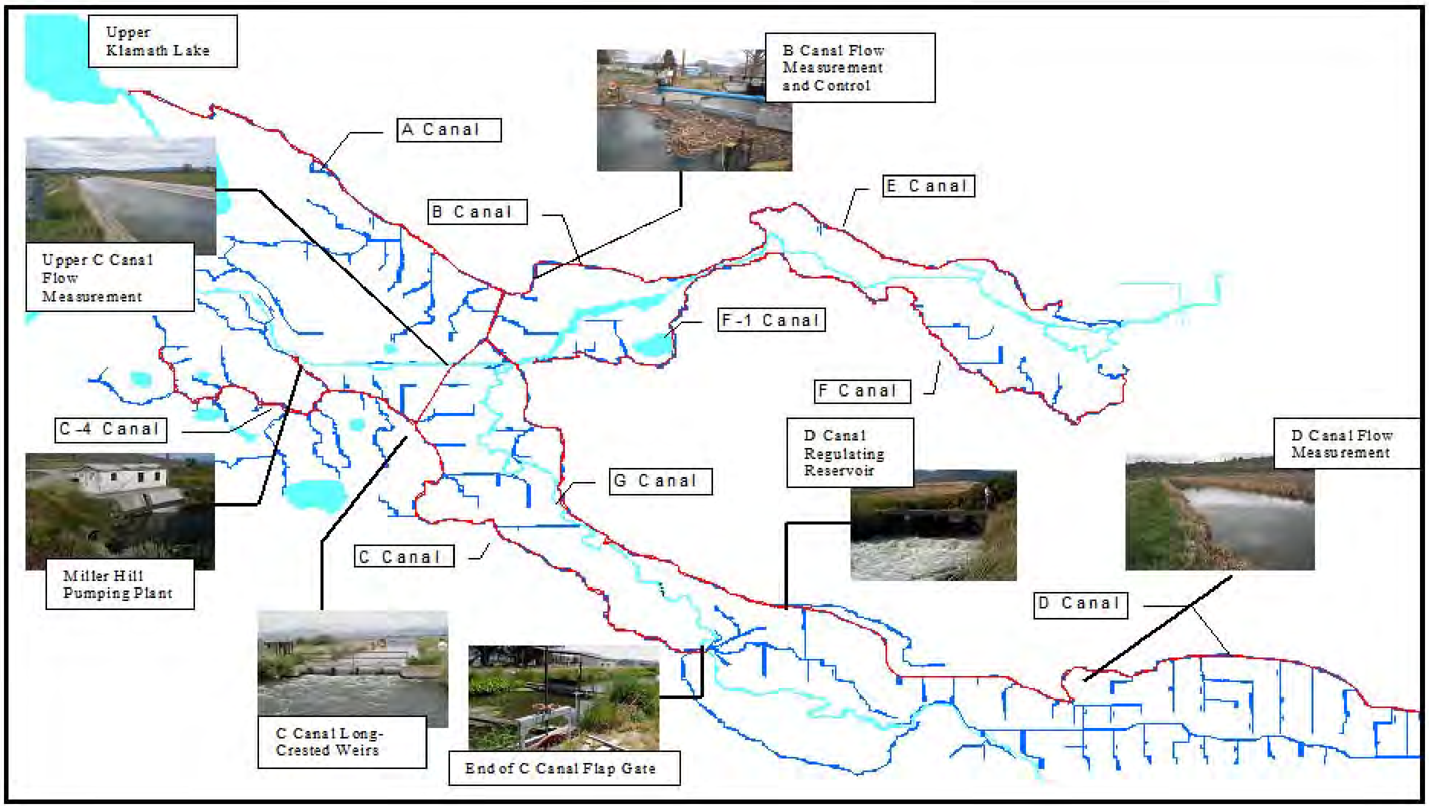
DIRECT TECHNICAL ASSISTANCE

ASIC



ITRC Water Projects in the Western US

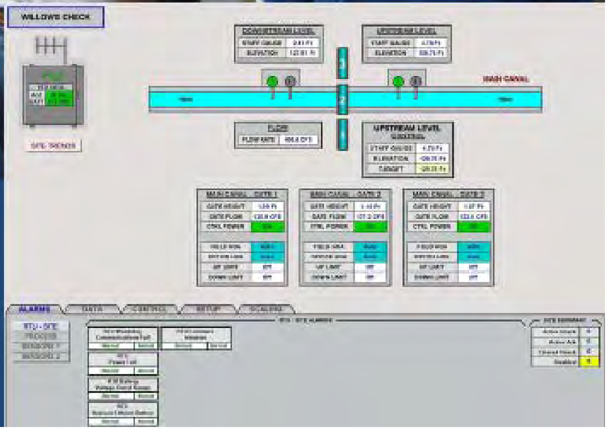
Modernization plan – Klamath Basin



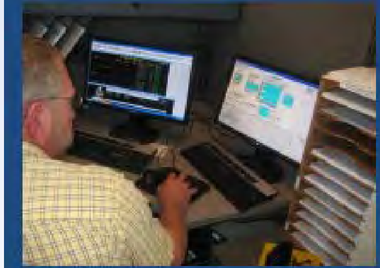
Current SCADA Projects (examples)

- *Glenn-Colusa Irrigation District*
- *Modesto Irrigation District*
- *Henry Miller Reclamation District*
- *Colorado River Indian Tribes*
- *Pecos Valley Artesian Conservancy District*
- *West Stanislaus Irrigation District*

Glenn-Colusa ID



Modesto Irrigation District



Henry Miller Reclamation District

SCADA-Related Automation Projects - Examples

ASIC

Central California Irrigation District (CCID)

Check structures performing U/S and D/S level control in 2 - 60-mile canals

Providing districts with new options

<u>ITRC Flap Gate</u>
Perhaps
300 in California.

ITRC FLAP GATE

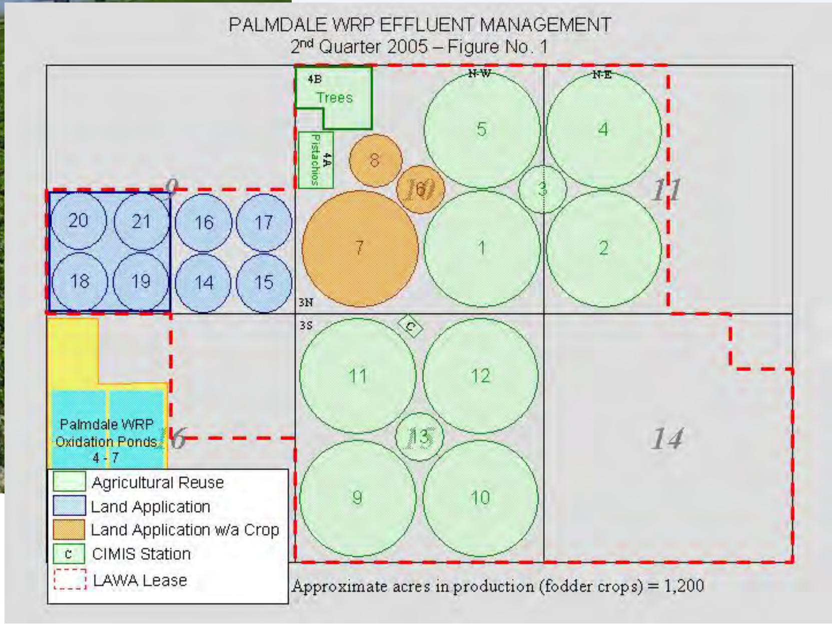
ITRC WEIR STICK (extremely basic)

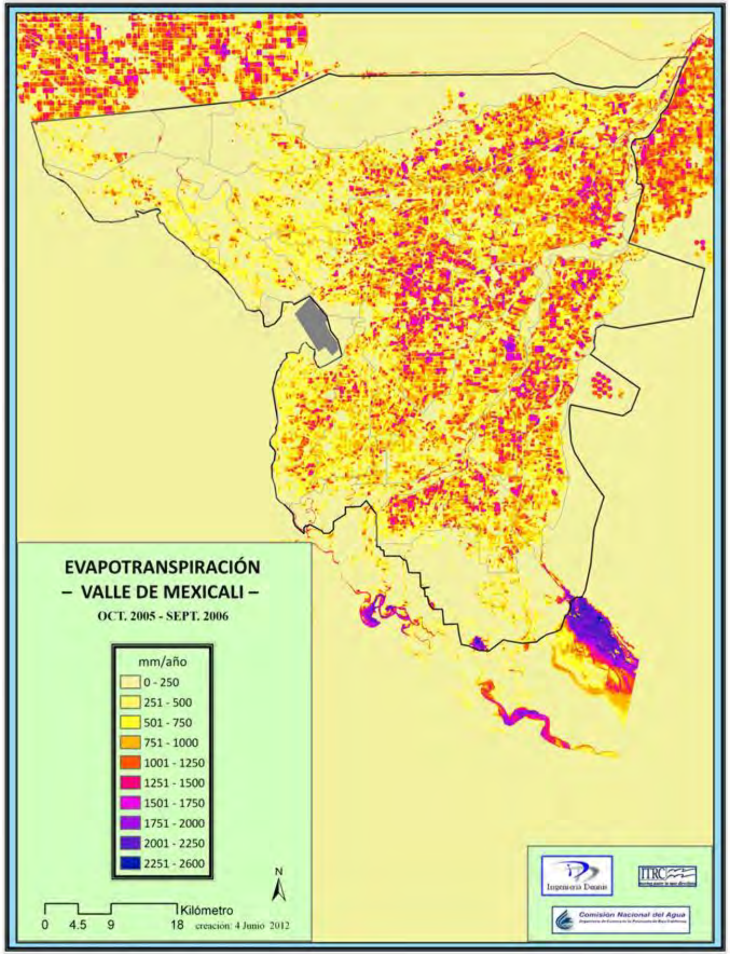
Multi-Purpose:

- Measure flow rate over a weir
- Pull boards
- Set boards
- Clear debris from water
- Walking support
- Animal defense stick

Palmdale and Lancaster

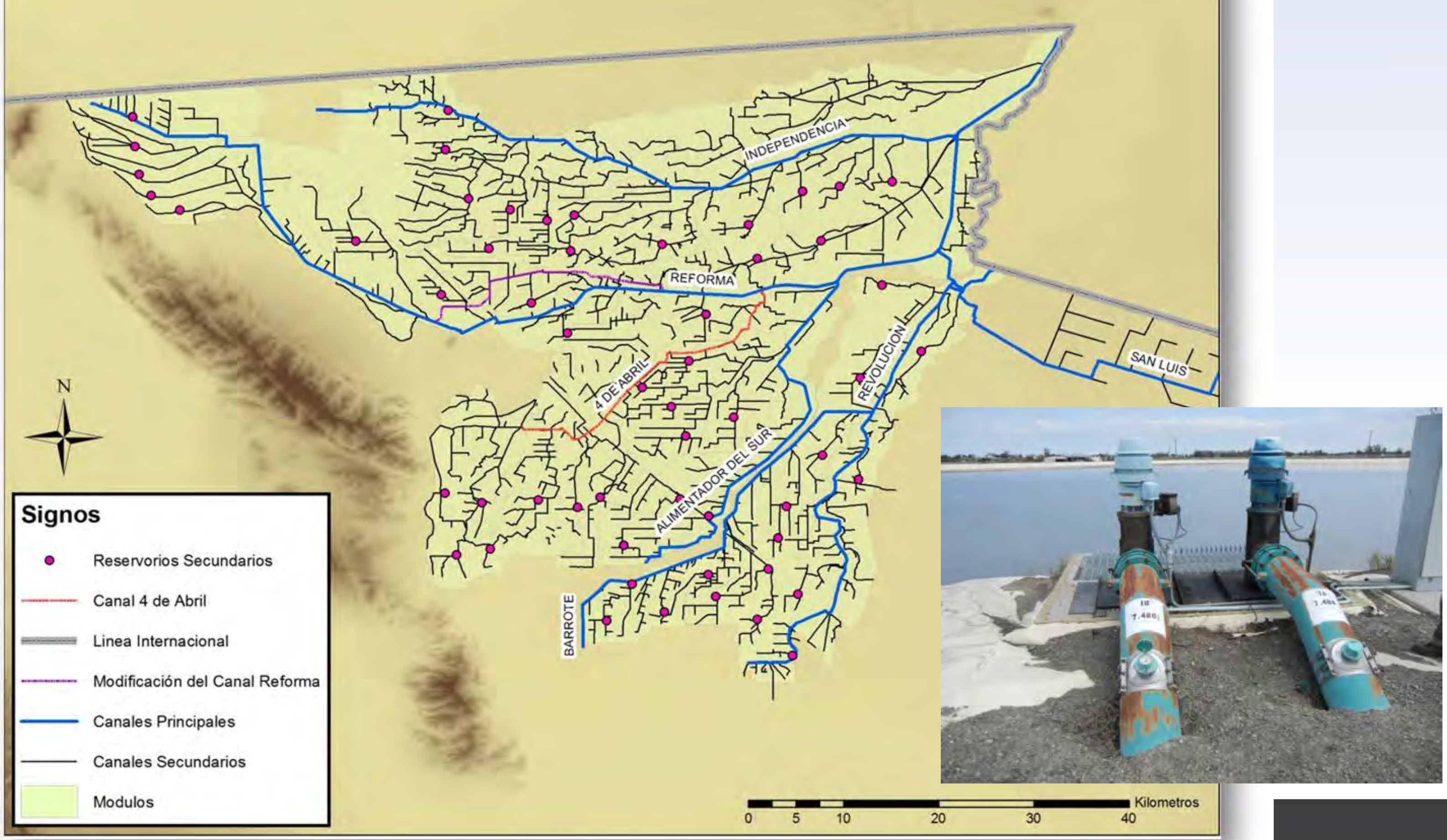
Municipal Effluent Disposal
27 Center Pivots





Proceso de METRIC, usando LANDSAT y datos climatológicos para averiguar el uso consuntivo de agua.

Ubicaciones Propuestas para Reservorios de Canales Laterales



Hopefully, this provides an idea of what ITRC does…

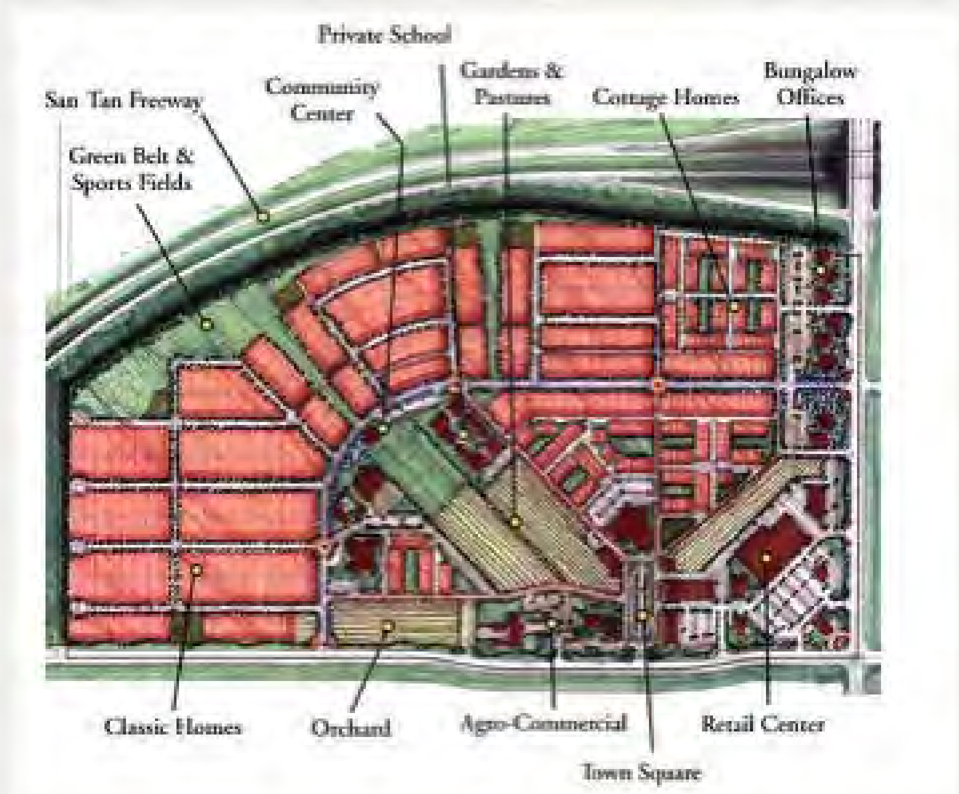
Questions?

Gloria Broming

Bringin' water to the urban farm!

A look into the design and operational considerations for irrigation and water needs

Sendero Farm, Rancho Mission Viejo



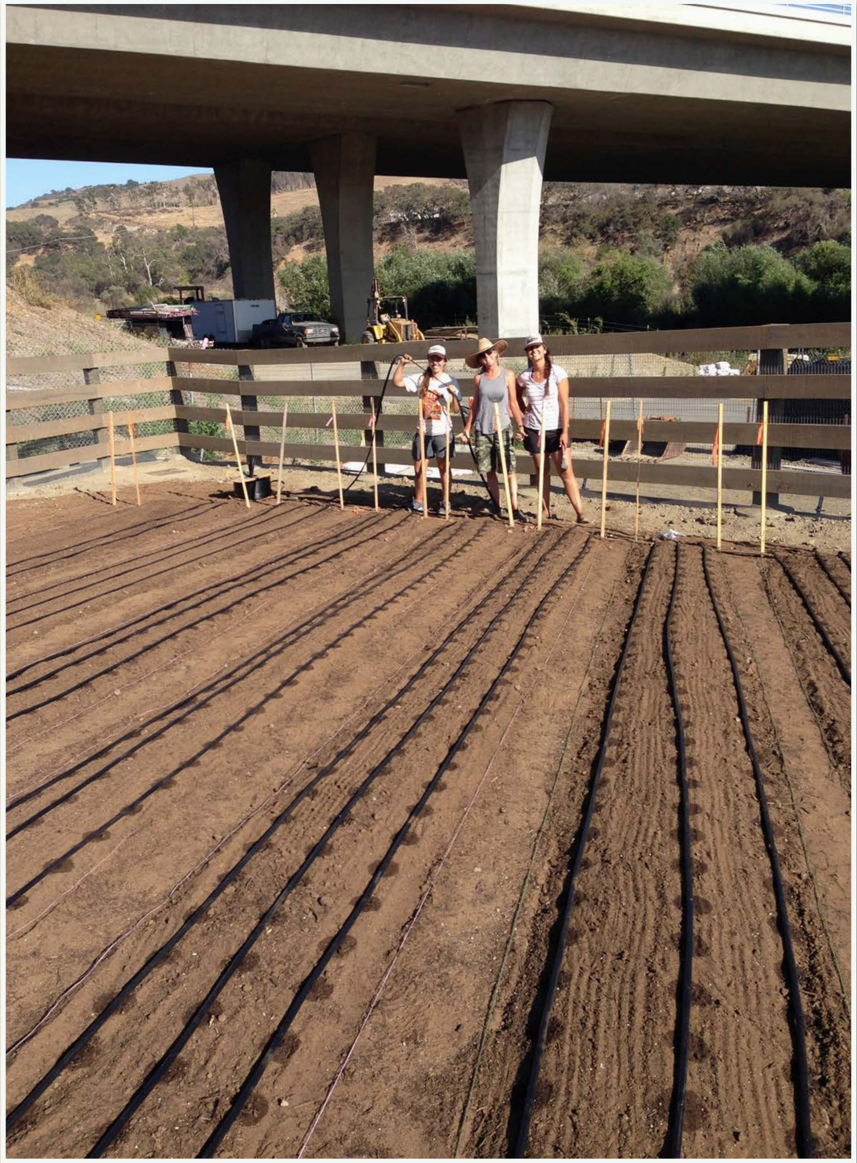
Urban Farming in Agrihoods - The New Normal

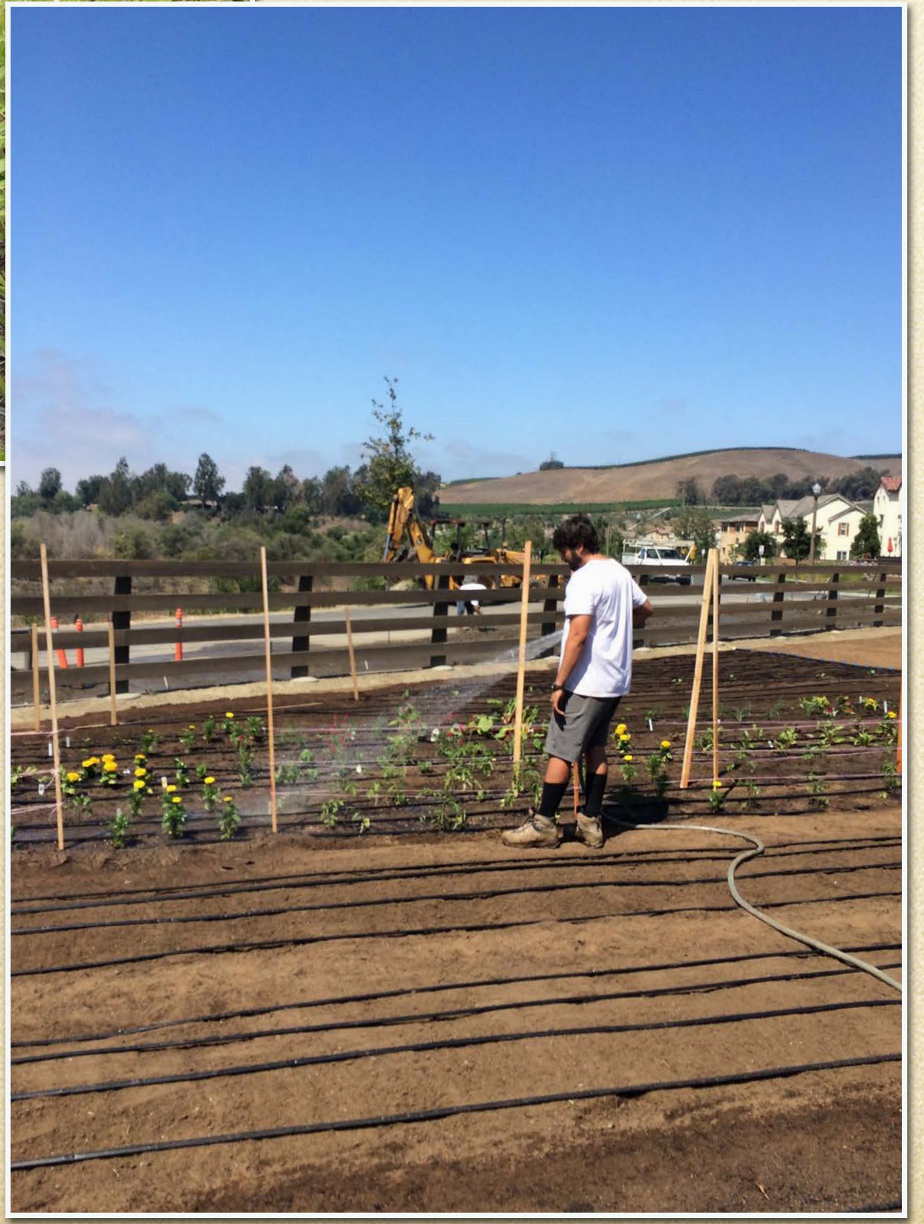
Farm Design Aesthetics

When the norm doesn't always apply…

Is that a hose bib? Valve? Or…

Raised
beds
v.
In-ground





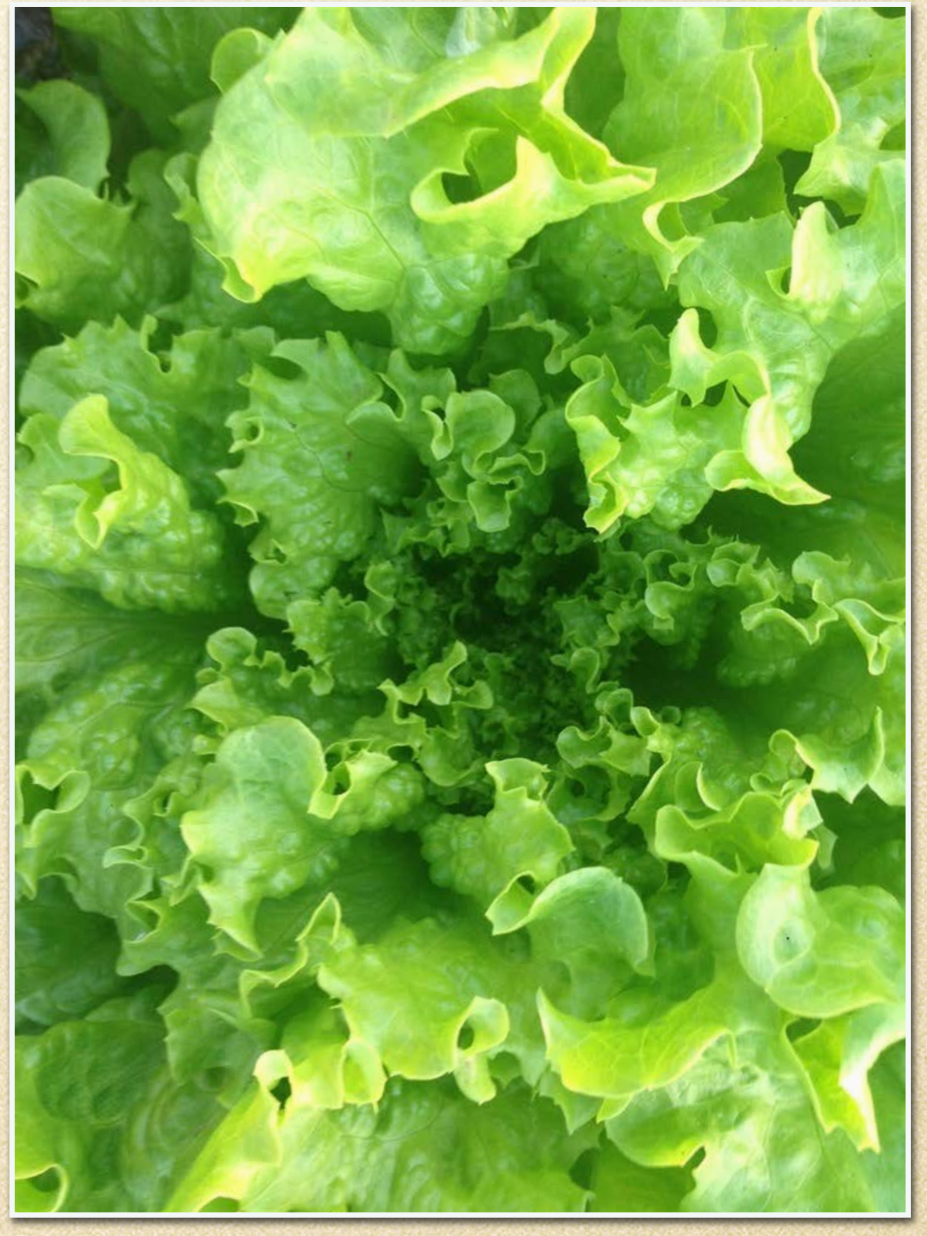
Designing for a farm and not a lawn

- **Macro consideration of space**
- **Crop needs**
- **Flexibility**
- **Efficiency both cost and usage**
- **Management**
- **Soil Composition**

Liquid Gold…sometimes

Don’t grow lettuce in the summer!

- **High**: Turf/Celery
- **Moderate**: Mediterranean/Lettuce
- **Low**: Succulents
- **Very Low**: Cacti and Natives, Dry Farming Tomatoes, Potatoes and Winter Squash



Water Needs Comparison

Water Needs Comparison

Water Usage	Images	Ornamental	Edible	Sippers once established	Images
High		Turf	Broccoli, cabbage, celery, cauliflower, lettuce and watercress		
Moderate		Ash, fan palm, sycamore	Stone Fruit: Peach, plum, avocado, apples, citrus,		
			Tomatoes, peppers	Water to establish then less once fruit has set	
Low		Summer Dry Plants	Figs, pomegranates, pineapple Guava	Once established can tolerate 3-6 weeks between watering cycles	

Average Water Needs

- Most vegetable crops require one inch or more of water each week during the growing season—this equals about 3/4 of a gallon of water per plant. In hot, dry conditions vegetables may demand more water.

California Gardening

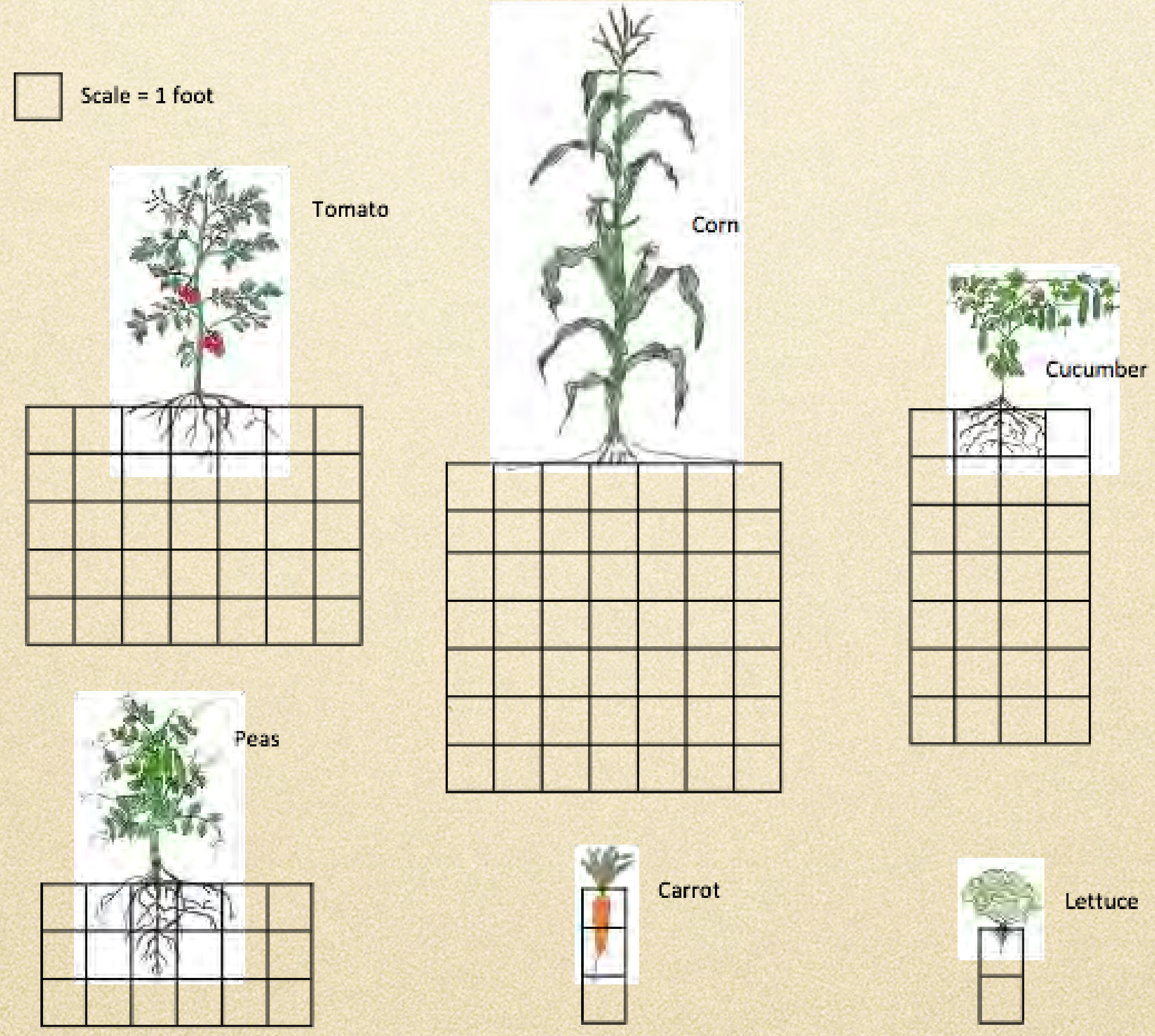
http://cagardenweb.ucdavis.edu

Vegetables | How do I water my vegetable garden? | Rooting depths

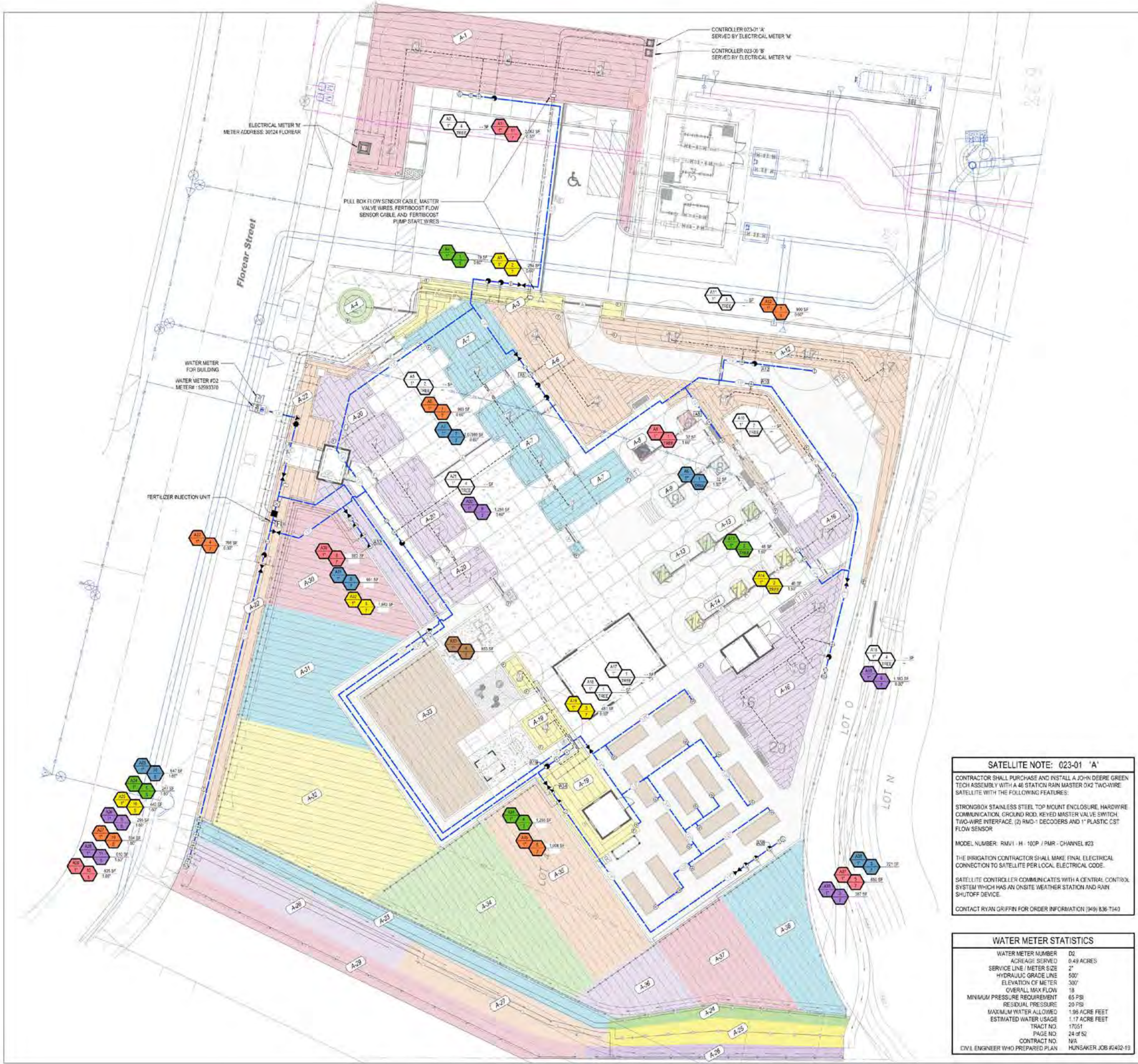
Comparative Rooting Depths of Common Garden Vegetables – Pam Geisel

These drawings illustrate the approximate rooting depth of different types of vegetables. The more squares, the larger the rooting depth and rooting area. These vegetables will do best with longer, less frequent and slow irrigation so that the root zone is entirely filled with water. Those plants with fewer squares typically have a much smaller root zone and will require more frequent but shallower irrigation.

These are only approximate rooting depths. Heavy soils, soils that are compacted, have hard pan, or clay layers may limit rooting depth significantly. Adjust irrigation accordingly. Use a shovel or soil probe to determine if water is penetrating deep enough after you have completed an irrigation cycle.



Illustrations with permission from UC Statewide Integrated Pest Management Program



AS-BUILT LEGEND

RM	DOMESTIC WATER METER
	RP BACKFLOW
	PRESSURE REGULATOR
	MASTER VALVE
	FLOW SENSOR
	ISOLATION VALVE
	CONTROL VALVE
	DRIP CONTROL VALVE
	ROW CROP DRIP CONTROL VALVE
	QUICK COUPLER
	HOSE BIB
	DRIP FLUSH VALVE
	LIGHTNING ARRESTOR
	MAINLINE AIR RELIEF
	PULL BOX
FI	FERTILIZER INJECTOR
	TREE IRRIGATION
	PRESSURE MAINLINE
	COMMUNICATION CABLE
	IRRIGATION CONTROLLER
	ELECTRICAL METER

HYDROZONE LEGEND

A1 · 60 · 10,000 SF

- DENOTES STATION NUMBER
- DENOTES VALVE FLOW (GPM)
- DENOTES AREA
- DENOTES PRECIP. RATE
- DENOTES HYDROZONE
- DENOTES VALVE SIZE

HYDROZONE KEY

NO.	SPECIES	PLANT FACTOR	IRRIGATION TYPE
1	TURF	HIGH - VARIABLE	PRECISION SPRAY
2	TURF	HIGH - VARIABLE	ROTOR
3	TURF	MOD - VARIABLE	PRECISION SPRAY
4	TURF	MOD - VARIABLE	ROTOR
5	SHRUB	MOD	SPRAY
6	SHRUB	MOD	ROTOR
7	SHRUB	MOD	DRIP
8	SHRUB	LOW	SPRAY
9	SHRUB	LOW	ROTOR
TREE			
POTS			

LATERAL PIPE SIZING LEGEND

NO 1/2" PIPE PERMITTED

- 3/4" MINIMUM
- 1"
- 1-1/4"
- 1-1/2"
- 2"
- 2-1/2"
- 3"

SLEEVE SIZING LEGEND

REFER TO IRRIGATION LEGEND FOR SLEEVE MATERIAL. REFER TO DETAIL FOR BURIAL REQUIREMENTS

A	(2) 2"	H	(2) 4"
B	(3) 2"	I	(3) 4"
C	(4) 2"	J	(4) 4"
D	(2) 3"	K	(5) 4"
E	(3) 3"	L	(1) 6" + (2) 4"
F	(4) 3"	M	(1) 6" + (3) 4"
		N	(1) 6" + (4) 4"

G — GALVANIZED SLEEVE - TO BE MINIMUM 2X DIAMETER OF PIPE OVER TERRACE DRAIN

SATELLITE NOTE: 023-01 'A'

CONTRACTOR SHALL PURCHASE AND INSTALL A JOHN DEERE GREEN TECH ASSEMBLY WITH A 46 STATION RAIN MASTER DX2 TWO-WIRE SATELLITE WITH THE FOLLOWING FEATURES:

STRONGBOX STAINLESS STEEL TOP MOUNT ENCLOSURE, HARDWIRE COMMUNICATION, GROUND ROD, KEYED MASTER VALVE SWITCH, TWO-WIRE INTERFACE, (2) RMD-1 DECODERS AND 1" PLASTIC CST FLOW SENSOR

MODEL NUMBER: RMV1 - H - 100P / PMR - CHANNEL #23

THE IRRIGATION CONTRACTOR SHALL MAKE FINAL ELECTRICAL CONNECTION TO SATELLITE PER LOCAL ELECTRICAL CODE.

SATELLITE CONTROLLER COMMUNICATES WITH A CENTRAL CONTROL SYSTEM WHICH HAS AN ONSITE WEATHER STATION AND RAIN SHUTOFF DEVICE.

CONTACT RYAN GRIFFIN FOR ORDER INFORMATION (949) 836-7940

WATER METER STATISTICS

WATER METER NUMBER	D2
ACREAGE SERVED	0.49 ACRES
SERVICE LINE / METER SIZE	2"
HYDRAULIC GRADE LINE	500'
ELEVATION OF METER	300'
OVERALL MAX FLOW	18
MINIMUM PRESSURE REQUIREMENT	65 PSI
RESIDUAL PRESSURE	20 PSI
MAXIMUM WATER ALLOWED	1.96 ACRE FEET
ESTIMATED WATER USAGE	1.17 ACRE FEET
TRACT NO.	17051
PAGE NO.	24 of 52
CONTRACT NO.	N/A
CIVIL ENGINEER WHO PREPARED PLAN	HUNSAKER JOB #2402-19

0 5 10 20

AS-BUILT

023-01

1 OF 1

RMV PLAN CONTROL

Plan Set: E Date: 09/25/14

CONSULTANTS

REVISIONS

09/25/14

PROJECT

URBAN AGRICULTURE COMMUNITY GARDEN

LANDSCAPE DEVELOPMENT PLAN
TRACT 17453, LOT 42
COUNTY OF ORANGE, CALIFORNIA

RANCHO MISSION VIEJO
28811 ORTEGA HIGHWAY, SJC 92692
CONTACT: JENNIFER TAYLOR (949) 240-3363

IRRIGATION PLAN

PROJECT STATUS		
OWNER ISSUE	10/14/13	BID ISSUE
AGENCY ISSUE	11/15/13	CONST. ISSUE 09/25/14

DRAWN BY: S.H.
CHECKED BY: S.H.
DATE: 9/25/14

JOB NO. 1730040
SHEET

LI-1

1 OF 7

AS-BUILT LEGEND

- DM — DOMESTIC WATER METER
- BACKFLOW DEVICE
- MASTER VALVE
- FLOW SENSOR
- ISOLATION VALVE
- DRIP CONTROL VALVE
- QUICK COUPLER
- HOSE BIB
- FI — FERTILIZER INJECTOR
- IRRIGATION CONTROLLER

SATELLITE NOTE: 023-01 'A'

CONTRACTOR SHALL PURCHASE AND INSTALL A JOHN DEERE GREEN TECH ASSEMBLY WITH A 48 STATION RAIN MASTER DX2 TWO-WIRE SATELLITE WITH THE FOLLOWING FEATURES:

STRONGBOX STAINLESS STEEL TOP MOUNT ENCLOSURE, HARDWIRE COMMUNICATION, GROUND ROD, KEYED MASTER VALVE SWITCH, TWO-WIRE INTERFACE, (2) RMD-1 DECODERS AND 1" PLASTIC CST FLOW SENSOR.

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0 5 10 20

AS-BUILT

023-01

1 OF 1

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REVISIONS

09/25/14

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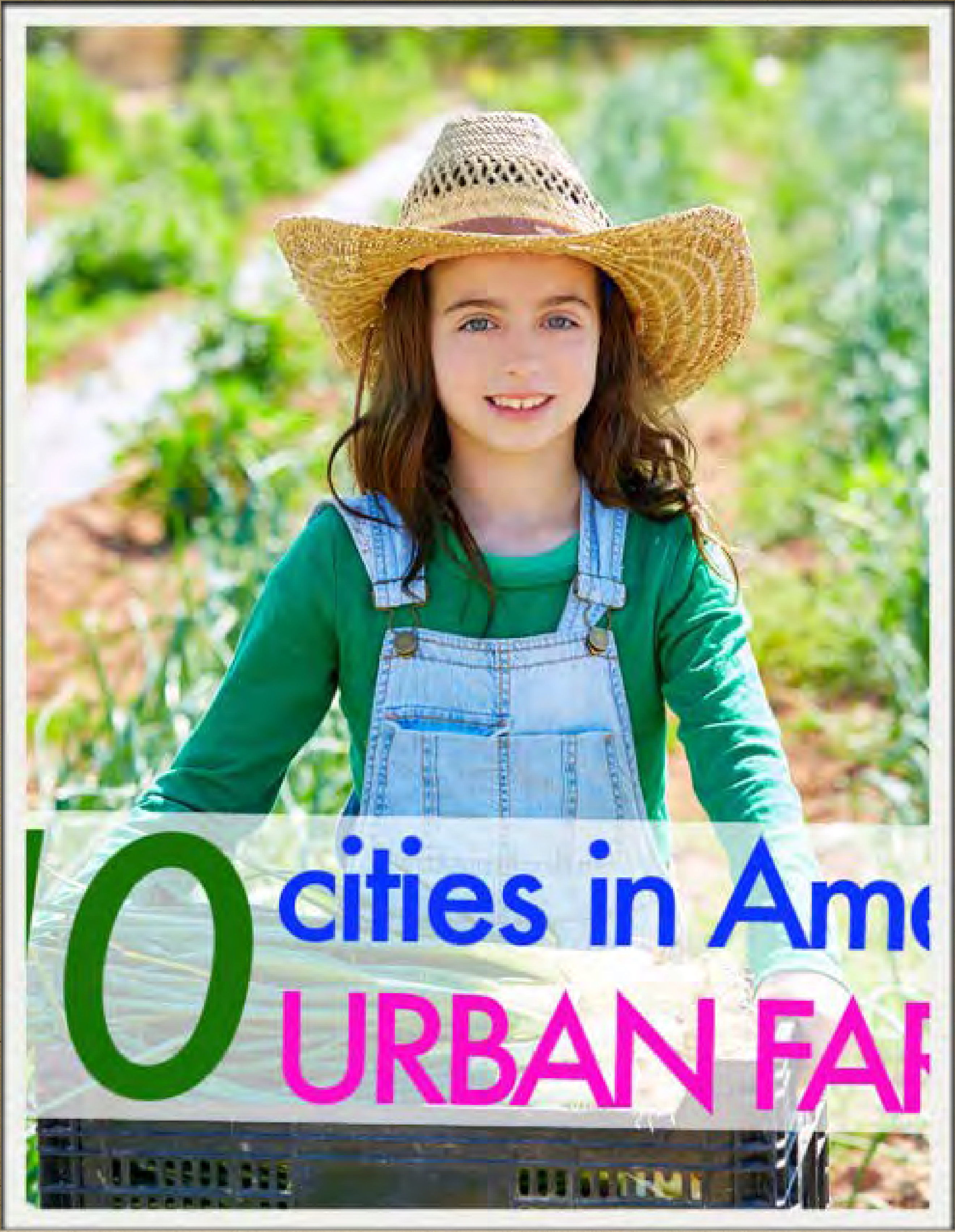
DRAWN BY: S.H.
CHECKED BY: S.H.
DATE: 9/25/14

JOB NO. 1730040
SHEET
LI-1
1 OF 7

Don’t learn the hard way!


6"Tape
12"Tape
24"Tape
12"Tubing
18"Tubing



Anticipate your client…the farmer!

Q&A

Peter Estournes

Effective Design Solutions for Drip Irrigation

Peter Estournes

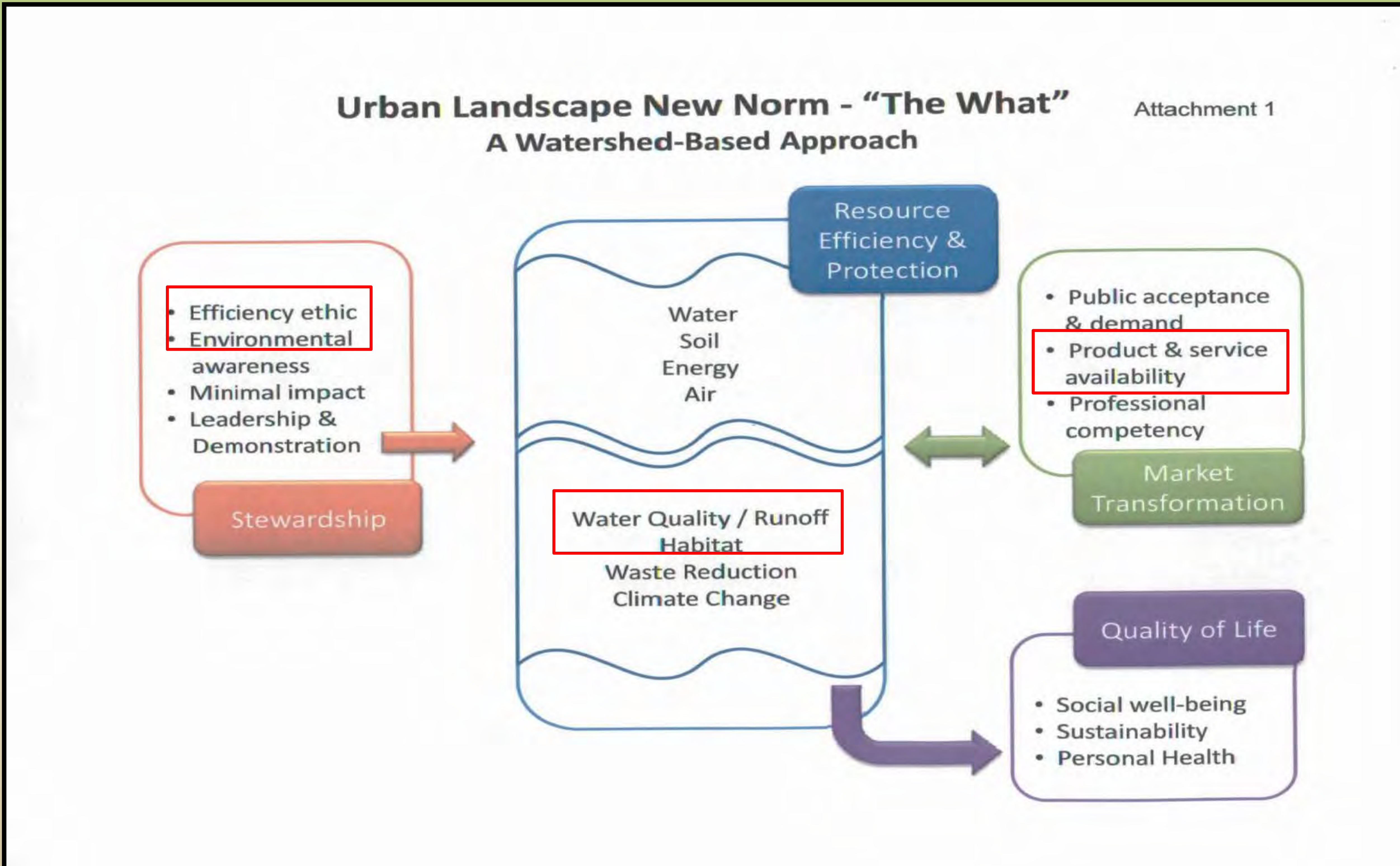
Its Hip to Drip

- MWELO 2015
- CUWCC'S New Normal
- Drought
- Sustainability
- Graywater
- Regulations
- Invisible Water

Drip Irrigation – MWELO Definition

MEANS - any non spray low volume irrigation system utilizing emission devices with a flow rate measured in gallons per hour. Low volume irrigation systems are specifically designed to apply small amounts of water slowly at or near the root zones of plants

California Urban Water Conservation Council – New Normal For Landscapes



Why Use Drip Irrigation?

We are told…

- Drip irrigation saves water because little is lost to runoff or evaporation.
- This watering method also promotes healthy plant growth, controls weed growth, and reduces pest problems.

Advantages:

- More efficient and reduced (hopefully) water use
- Greater application uniformity
- Joint management of irrigation and Fertilization
- Limited weed growth and reduced weed germination
- Reduced pest problems
- Simplicity – less mechanized parts
- Low pumping needs
- Lower operating pressure
- Useful on slopes – low infiltration rate
- Adaptation
- Reduced weather related application issues (wind, evaporation)
- Ease of installation

Disadvantages:

- Biases against drip
- Drip irrigation requires maintenance and high-quality water
- Water-application pattern must match planting pattern
- Leak repair – vandalism
- High initial investment
- Consistent maintenance requirement
- More difficult to visually inspect
- Plants will outgrow initial system parameters
- Operation and management may require more attention
- Restricted plant root development

Helpful Hints

- Always use filtration
- Always use pressure reducers
- Education needed by professionals – no different than understanding other types of irrigation
- Must understand precipitation rates and how to measure
- Soil – plant – water relationships are a factor
- Water budgeting is still key to successful water management
- Emitters should not be buried but should be under mulch
- Subsurface drip irrigation better for groundcover/lawns
- Slower application rates mean longer run times
- Plant material health will be lead indicator for problems – check soil

Landscape Design Considerations

MWELO 2015 Revisions:

- Pressure regulation required
- Master shut off valves required
- Flow sensors for landscapes 5000sf and above
- Components must meet national standards
- Dedicated water meters or sub-meters to be installed – residential above 5000sf: non-residential @ 1000sf
- Minimum width for overhead irrigation - 10’

Landscape Design Considerations

MWELO 2015 Revisions:

- MAWA (ETAF) calculation drops from .7 to .55 for residential and .45 for non-residential
- Drops high water using plants such as cool season turfgrass to approx. 25% coverage in residential applications (old MWELO was 33%)
- Will not be able to use any high water using plants in non-residential settings
- Irrigation efficiency is now set at .81 for drip and .75 for spray

Landscape Design Considerations

- Pressure and flow testing – document on plans
- Soil testing to determine percolation rate – specify emitter sizing. Include test results in bid package
- Standardize products – the fewer the better include spec sheets
- Consider plant type, spacing and eventual size in selection of emission devices and where to place them
- Include Hydrozone information – Estimated Total Water Use by irrigation zone
- Review local water use restrictions (water days and times)
- Trees WILL be on their own valve

Drip System Design Considerations:

- Components from water meter to remote control valve are the same
- Allow room for filter and pressure reducer in valve box – pay attention to future servicing of valves when locating inside box
- Specify valves that will work at low volumes and spot them on plan
- Specify wire mesh barrier and landscape fabric around and under valve boxes to deter burrowing animals
- Place gravel at bottom of box and label valves
- If using Anti-siphon valves be sure they meet code – place drip filter and pressure reducer in valve box.
- Do not allow green colored valves boxes in plant areas

Drip Design Considerations:

Surface run drip:

- Specify industry standard ½" tubing and fittings not the tubing sold at big box stores (green stripe)
- For longer runs can use ¾" tubing, but may collapse in heat. Scratch in.
- Specify to stake tubing every 3-5 feet and "Scratch in"
- Specify tubing to get be close to edge of root ball of all small container plants as possible, part ways inboard for larger root balls
- Specify end caps at ends of runs and locate them on "as built"
- Specify to flush out tubing before installing emitters
- Ask to check operating pressure to quantify pressure reducer size

Drip Design Considerations:

Surface run drip:

- Emitter output selection depends on infiltration and percolation rates – all should be pressure compensating
- Standardize number of emitters per size of initial container plants came in (ex. 1 per 1 gallon, 2 per 5 gallon)
- Rule of thumb locate emitters approx. ½ to ¾ from base of plant to edge of root ball
- If needed install emitter at end of ¼” distribution tubing using transfer barb to connect to main tubing – do not extend more than 2’
- Always leave extra fittings and emitters for client for repairs

Drip Design Considerations:

Subsurface run drip:

- More difficult than surface run
- Lay out and installation more critical than surface run
- Less prone to vandalism
- Works better for ground cover, lawns and plantings spaced equally – needs 15psi operating pressure
- Please get trained by the distributor or manufacturer before attempting first install – there are nuances especially with regards to slopes.
- Precipitation rates can match spray irrigation – need infiltration and percolation rates
- Attempt to be part of verification of proper installation

Drip System Management

- Routine inspections especially for alt water sources – filters
- Longer run times – typically but not always
- Know soil type
- Tune valves
- Know where flushing points (end caps) are located
- Will probably need to add emitters as plants grow
- Be cautious when pruning low to the ground – esp. ornamental grasses
- Keep extra parts on hand – critters may cause issues
- Property owners can be a nuisance – adjusting controllers, soil looks dry, etc.

How much water to apply?

Arbutus 'Marina' – 20' x 15' in full sun with 10 emitters @ 1gph each

Formula: Weekly Eto x .4 x Tree Canopy (20' x 15')size x .62

Calculation: 1" x .4 x (7.5x7.5 x 3.14) x .62 = gallons for week
1" x .4 x 177 x .62 = 44 gallons

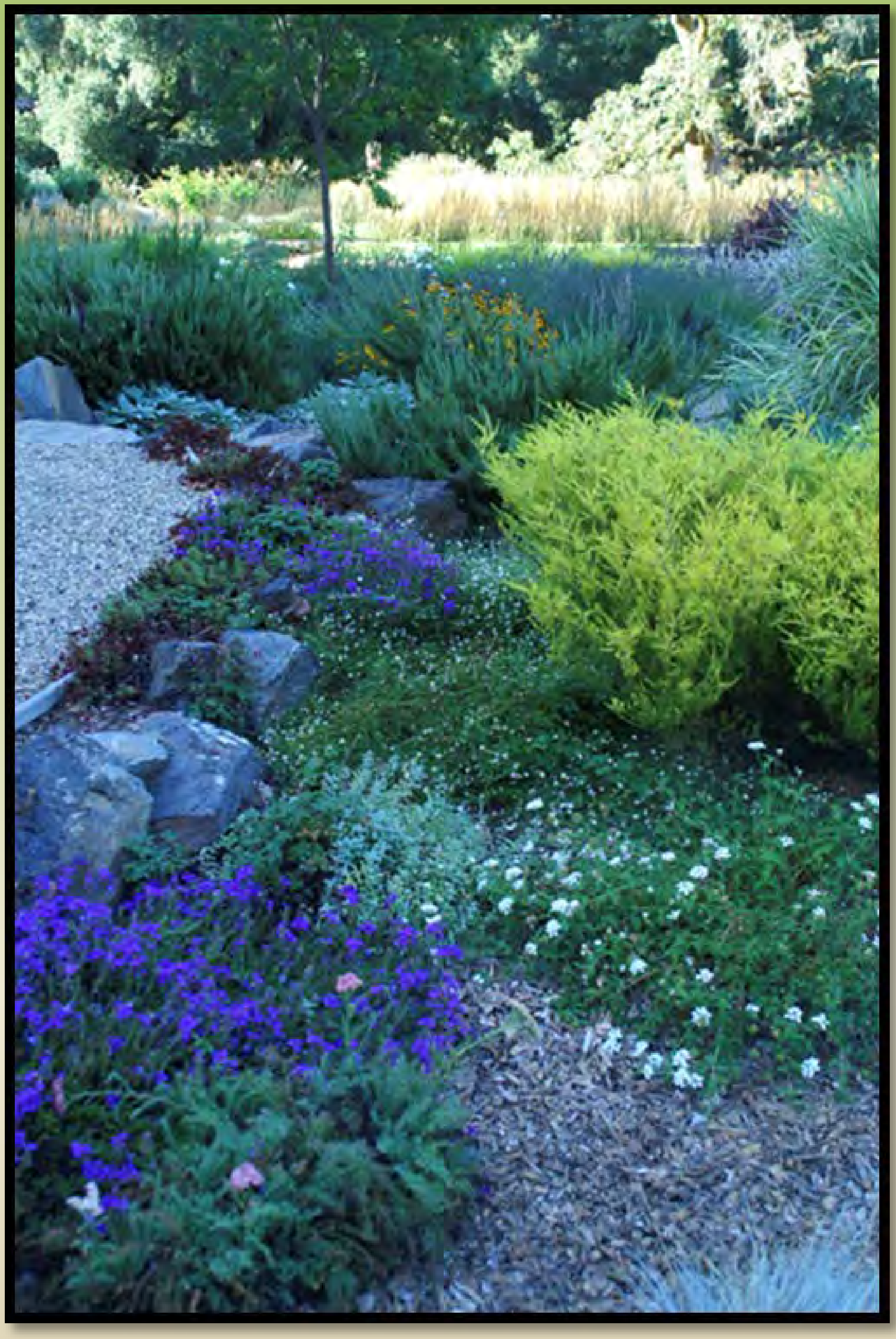
With 10 emitters = 4.4 gallons per emitter for week

2 day restrictions = 2.2 hour per day

Use 3 start times = 40-45 minutes each

Troubleshooting

- Flush valve on drip filter left open
- Filter clogged with silt, iron, sand, pipe shards
- Emitters get clogged by mineral deposits
- “Low” operating pressure (in line emitters should be at 15psi) – too many emitters
- Emitters are popping out of tubing
- Distribution tubing to long from emitter to plant
- Too much distribution tubing
- Quadra or Octa bubblers become brittle and distribution tubing pops off
- Emitters get buried by plants
- Subsurface inline emitters eventually allow roots to enter
- Subsurface installed incorrectly and “moves”



Trends

- Renewed focus on Drip Irrigation - MWELO
- Public sector is confident in drip irrigation – private sector not so much
- Irrigation schedules for new landscapes developed by designers to meet water budget
- Range in ETAF factors can affect MWELO calculations
- Irrigation systems not installed per plan an no as built plans
- Lack of irrigation inspections after installation

Effective Design Solutions for Drip Irrigation

Peter Estournes

Kelly Parkins

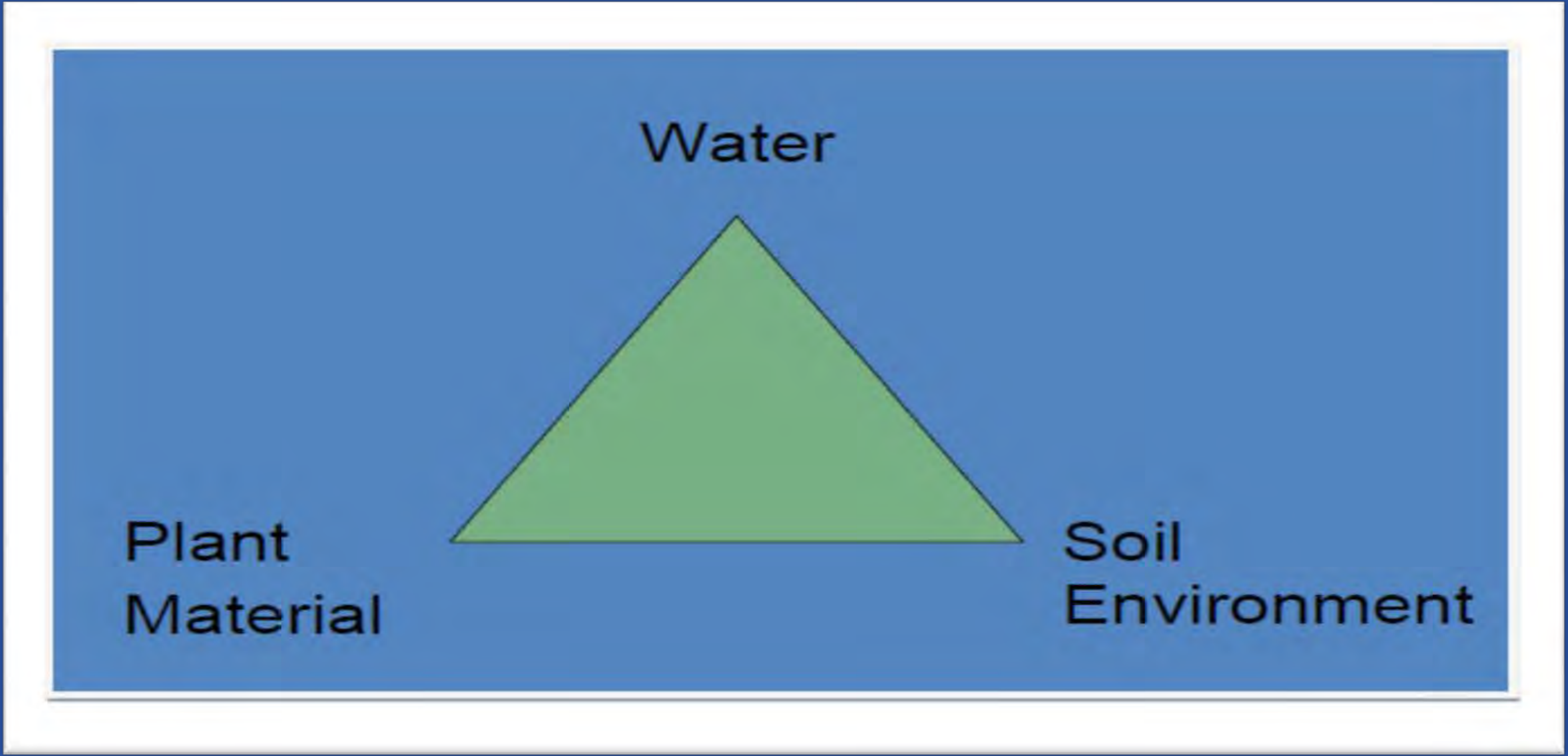
Turfgrass Production and Recycled Water

Kelly Parkins
City of Long Beach

Applying What We Know

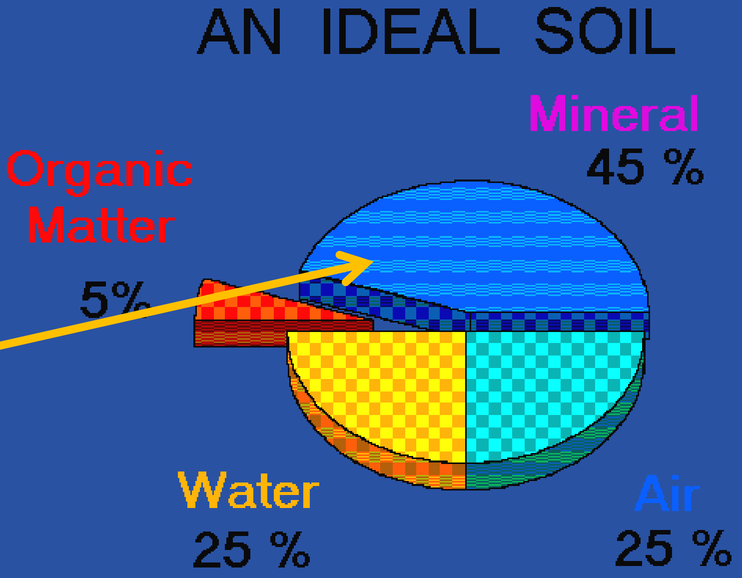
- On-going drought: potable water availability will continue to be limited
- Water quality will be variable
  - Recycled, potable, well water, etc
- Plant Selection will influence success in the production of landscaped areas
- Soil production and management will play a pivotal role

Horticultural Triangle



Understanding Soils …

Soil Texture

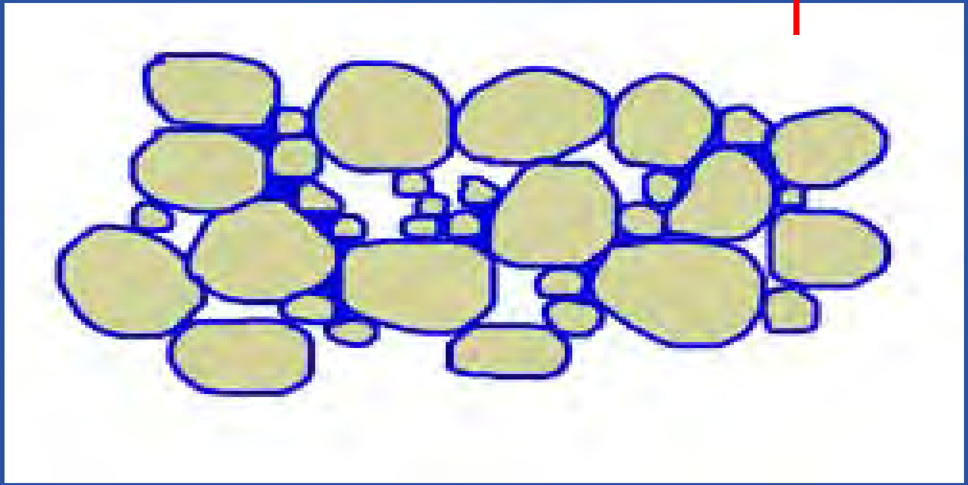


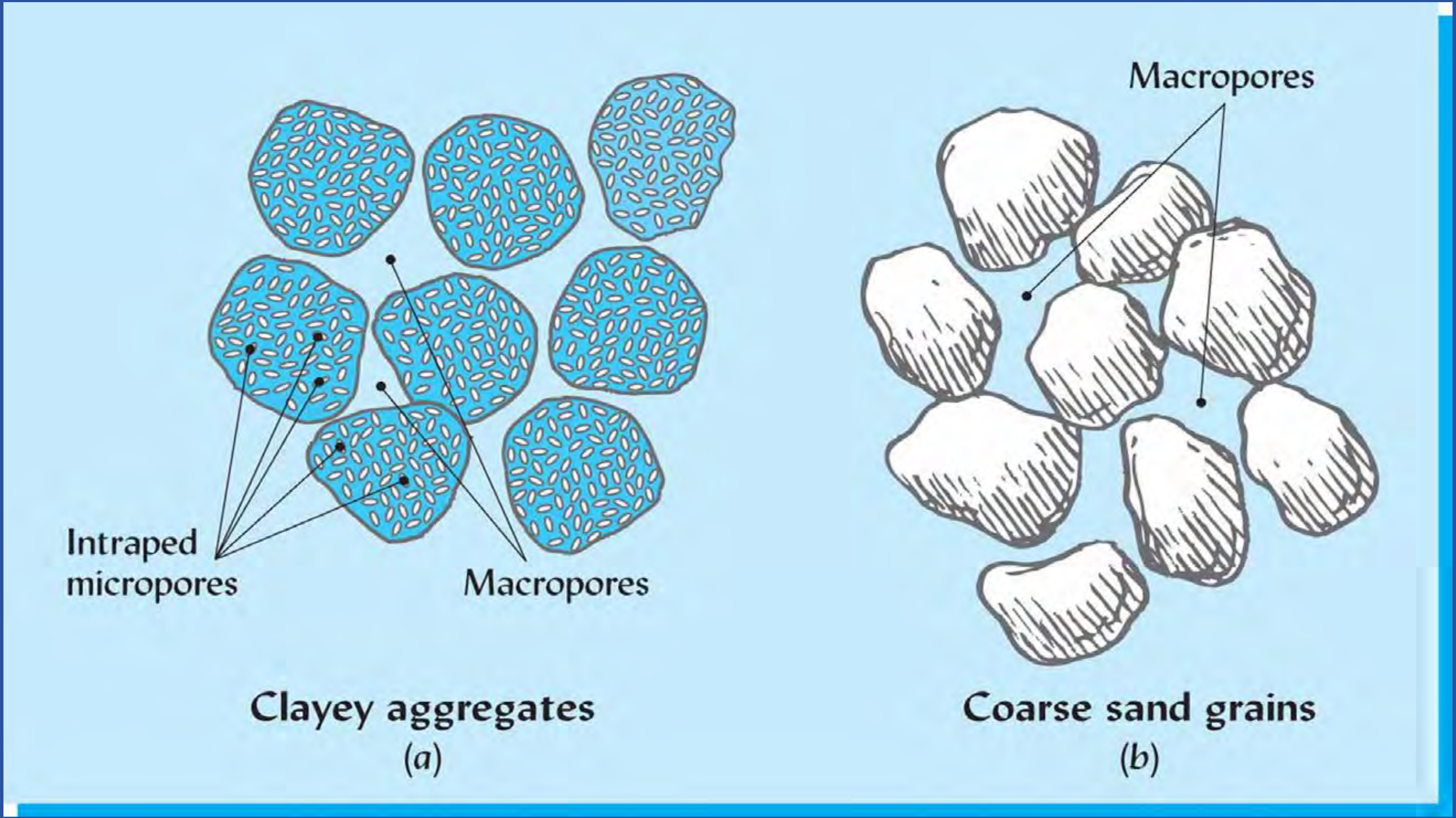
Soil Structure

Aggregation of Soil Particles

- Mix of air and water pore space - coherent mineral structure.

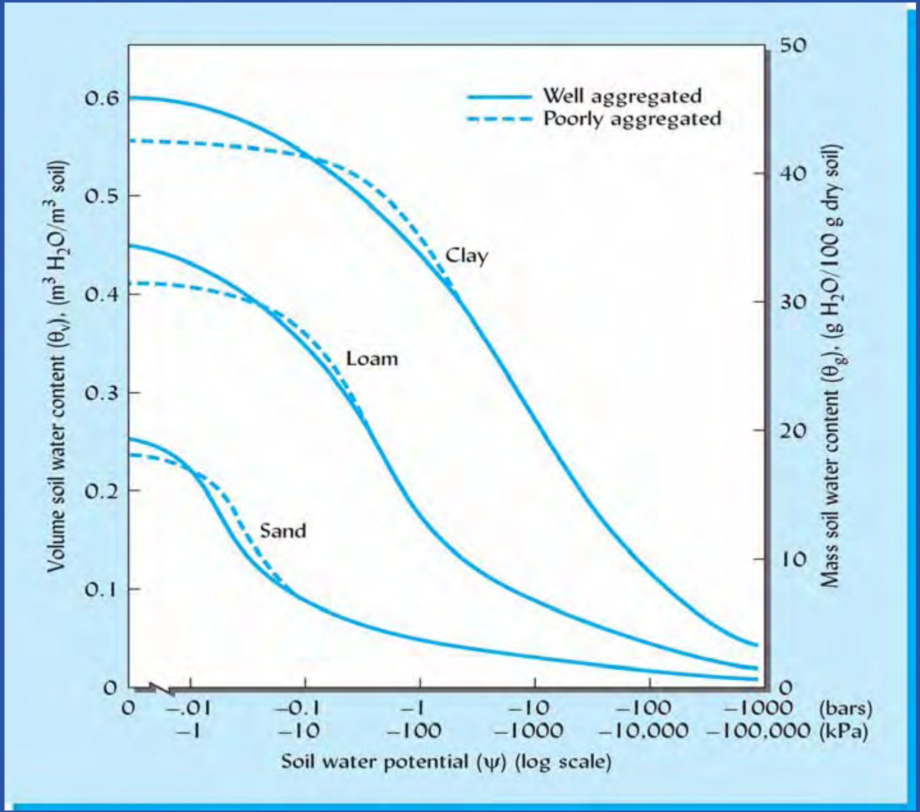
- Compacting forces
  - detrimental to the porosity
  - impacts both oxygen / water movement in the profile

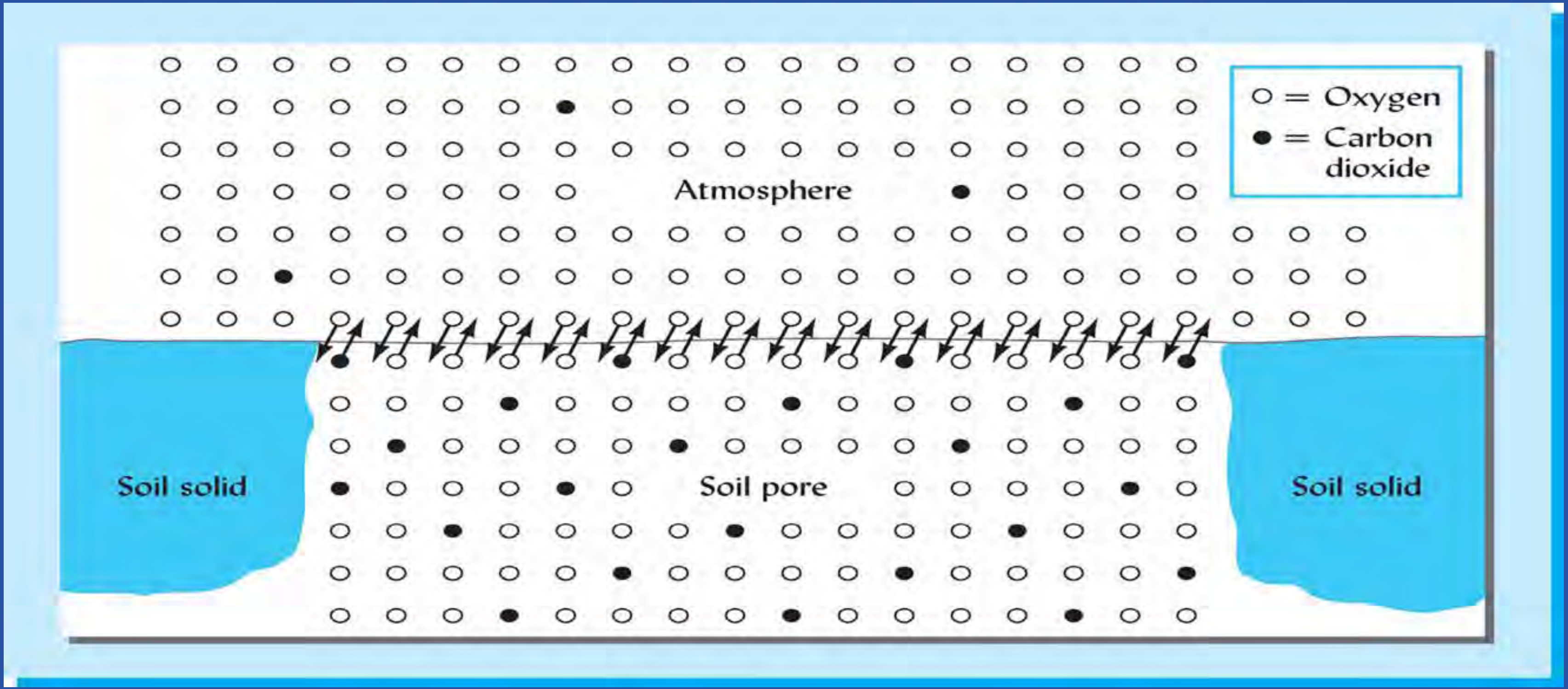




Brady and Weil 2008

Water Movement





Brady and Weil 2008

Air: O_2 21% CO_2 0.035%

Soil Air: O_2 lower CO_2 higher

Recycled Water Quality

Effect the soil and plant environment

- Water chemistry as it relates to quality
  - What components of water influence quality?
  - Distinguished from physical issues such as suspended solids and biological such as pathogens

Key Point: what your water carries to your soil,
will be what your soil becomes

Partial Summary of Irrigation Water Quality Guidelines

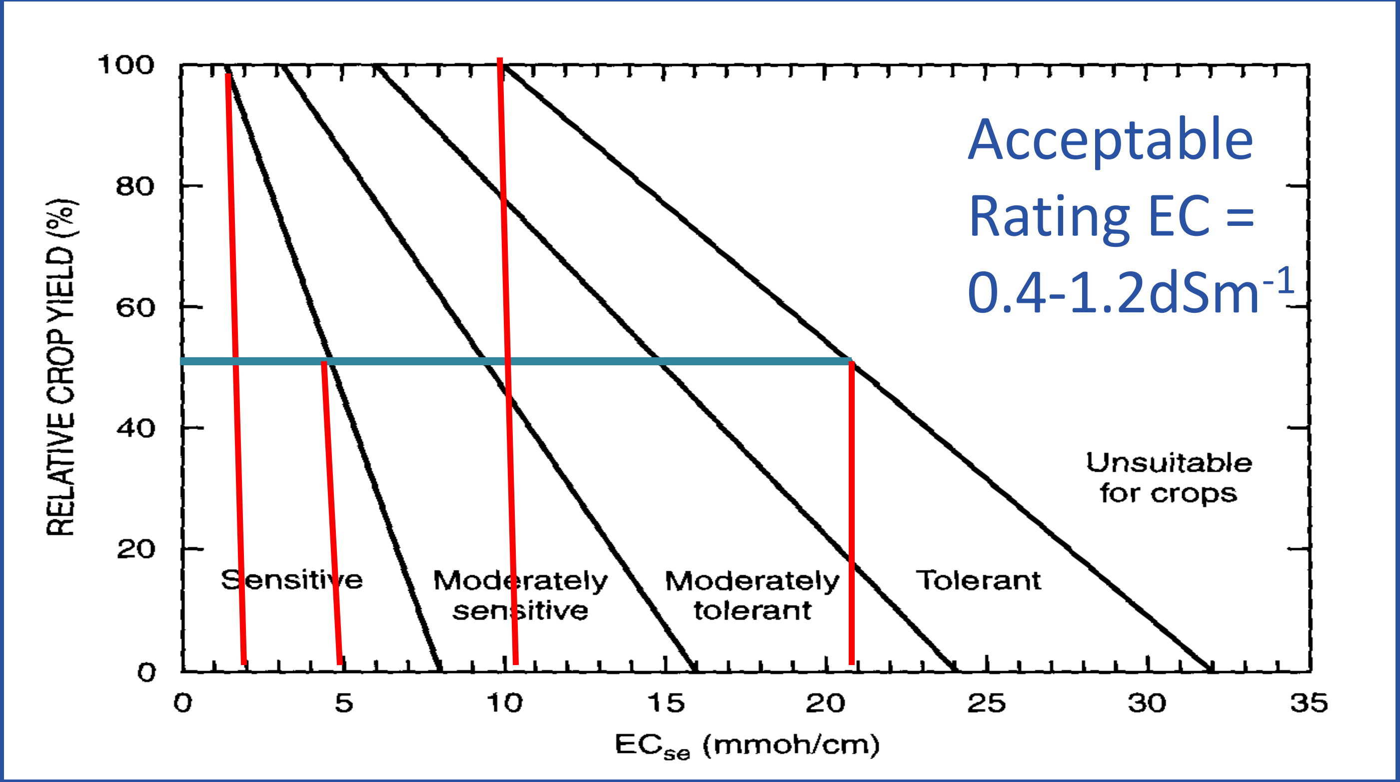
Water Parameter	Units	Desired Range	Usual Range[a]	Average Domestic[b]	Average Reclaimed[b]
General Water Characteristics					
pH	1-14	6.5-8.4	6.0-8.5	7.7	7.1
Hardness	mg/L	<150	-	-	-
Alkalinity	mg/L	<150	-	-	-
HCO_3	mg/L	<120	<610	174	194
CO_3	mg/L	<15	<3	3.0	0
Total Salinity (soluble salts)					
EC_w	dS/m	0.40-1.20	<3.0	0.8	1.1
TDS	mg/L	256-832	<2000	617	729
Sodium Permeability Hazard					
SAR_w	meq/L	<6.0	<15	1.9	3.1
adj RNa	meq/L	<6.0	<15	1.9	3.1
RSC	meq/L	<1.25	-	-2.30	-1.88
EC_w	dS/m	>0.41	-	-	-
Specific Ion Impact on Root Injury or Foilage Uptake Injury					
Na	mg/L	<70	-	-	-
Cl	mg/L	<70	-	-	-
B	mg/L	<0.50	<2.0	0.17	0.44

Lab Report-Irrigation Water Suitability

1. Salinity
   - Reduction in soil water availability in the rootzone
     - Plant unable to pull water away from salt
   - Measured by electrical conductivity
2. Soil permeability
   - Reduced infiltration and percolation of water
     - Sodium content relative to calcium and magnesium
     - Bicarbonate and carbonate concentrations
   - Measured by
     - SAR_w - low levels of carbonate, bicarbonate
     - adj Rna – accounts for carbonate, bicarbonate
     - Residual Sodium Carbonate (RSC) – formation of lime

Salinity

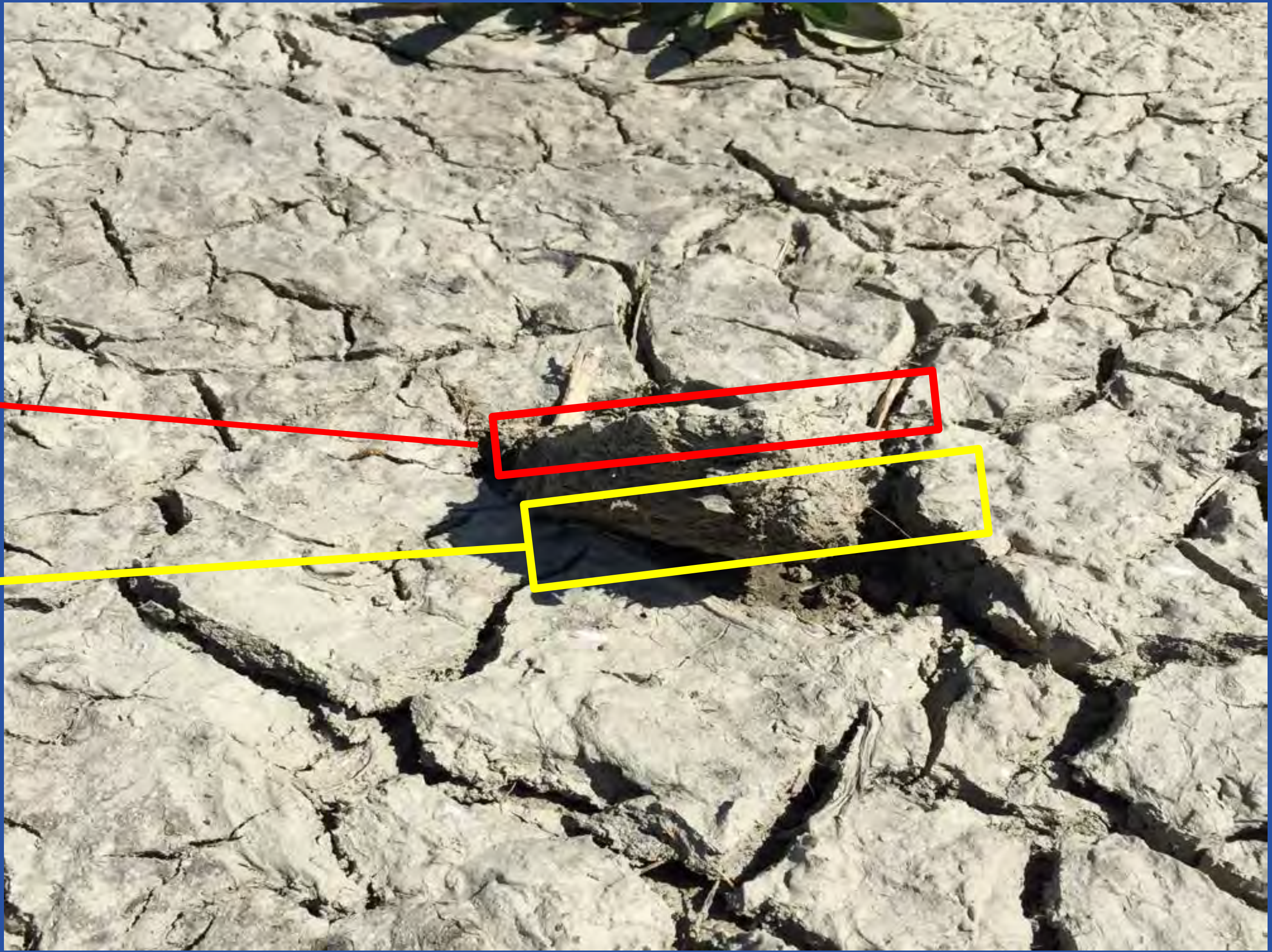
Measuring Soluble Salts



Reproduced from Havlin, Tisdale, Beaton, and Nelson 2005

Total soluble salts are measured by Ec or TDS

27 dSm^{-1}



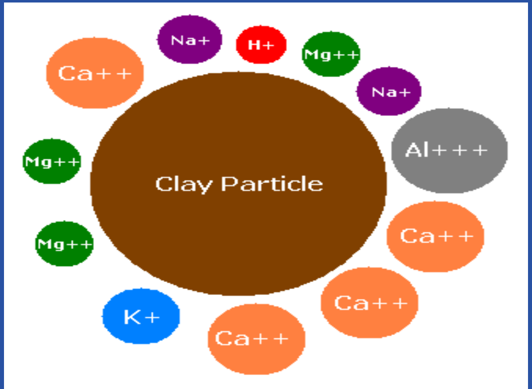
4.5 dSm^{-1}

Yerba mansa

Soil Colloids and Sodicity

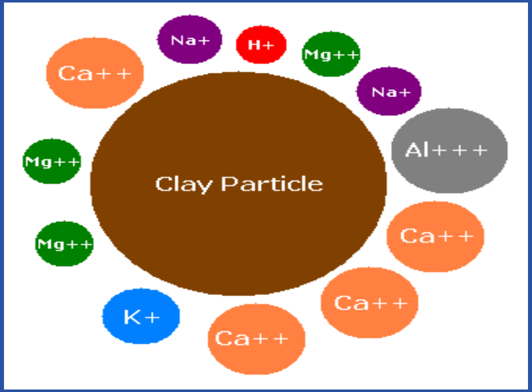
- Colloid: clay and humus particles in the 1-2 micrometer diameter range.
- Internal and external surface area per unit mass is extensive
- Internal and external surfaces carry varying charges
- Retention of cations (CEC), anions (AEC), and water on the surfaces of colloids is a key component of soil and plant interactions

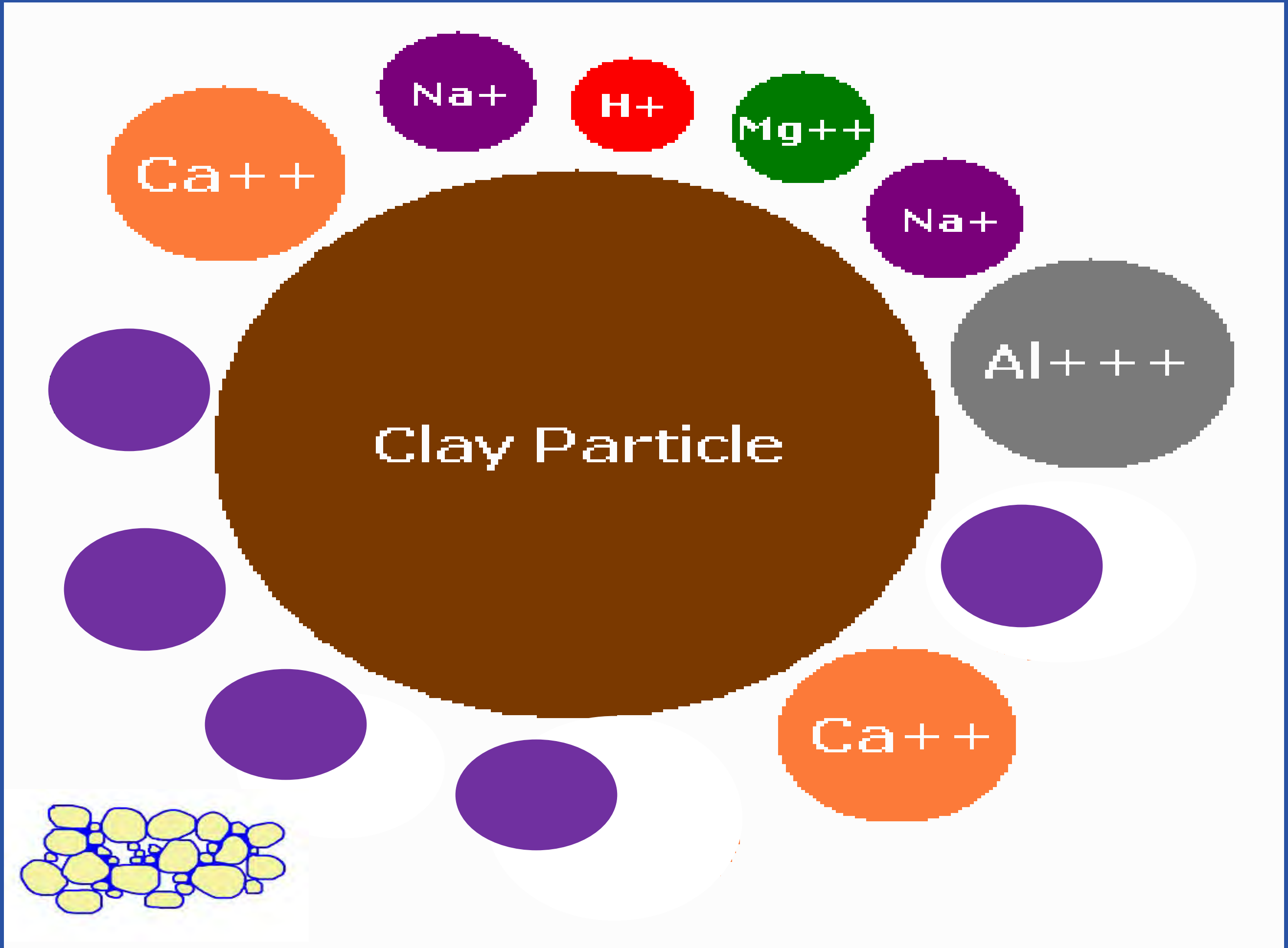
Soil Permeability

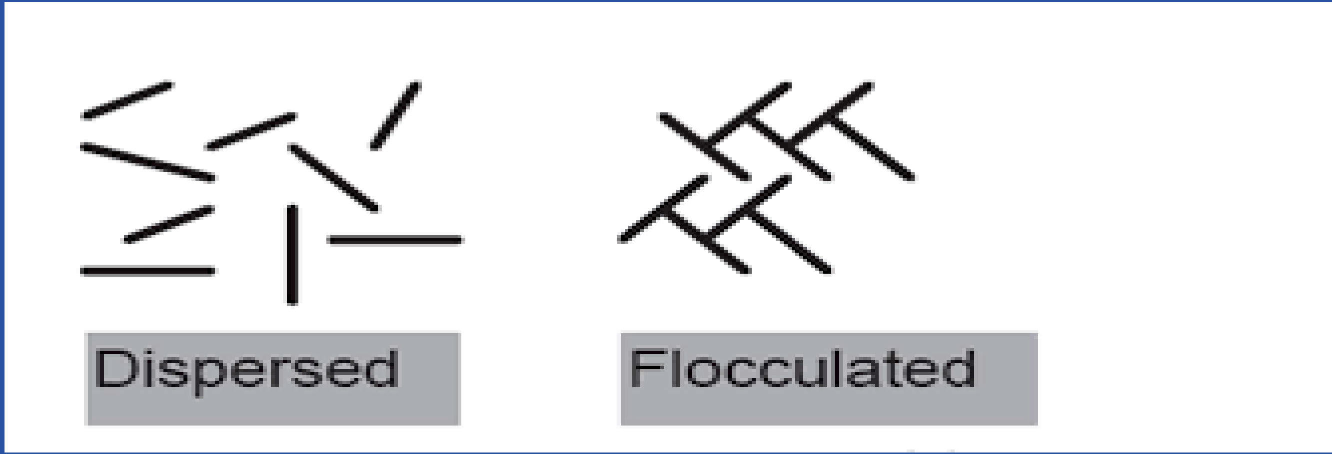


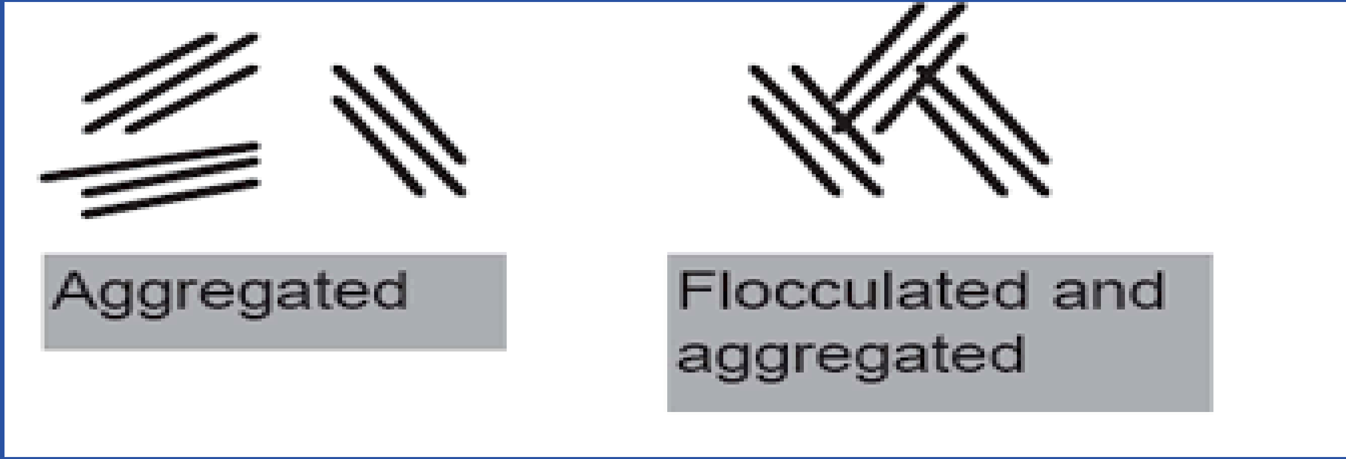
- Sodium levels are generally sufficient for plant *growth*
- Elevated levels of sodium in the water will accumulate in the soil
- Sodium acts to displace nutrients (ions) off of the soil colloid
- Excessive sodium saturation on the colloid cause the particles to disperse
- Dispersed soil negatively impacts water infiltration and aeration (gas exchange)
- Calcium and magnesium (minor) are the fix

Excessive proportion of sodium ions disperses soil

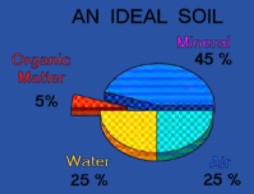





Dispersed
Flocculated


Aggregated
Flocculated and aggregated

Undisturbed Core Samples



Lab ID No.	Sample	Particle Density[1] (g/cc)	Bulk Density (g/cc)	Ksat Infiltration Rate (in/hr)	Total Porosity %	Aeration Porosity %	Capillary Porosity[2] %
24103-1a	Field #1, 0 – 3"	2.57	1.21	0.09	52.8	7.8	45.0
24103-1b	Field #1, 3 – 6"	2.61	1.62	7.1	37.9	16.5	21.4
24103-2a	Field #2, 0 – 3"	2.58	2.4	2.4	50.5	13.0	37.5
24103-2b	Field #2, 3 – 6"	2.62	1.54	19.8	41.1	24.3	16.8
24103-3a	Field #3, 0 – 3"	2.57	1.20	1.0	53.4	8.7	44.7
24103-3b	Field #3, 3 – 6"	2.62	1.59	15.5	39.2	21.0	18.2
24103-4a	Field #4, 0 – 3"	2.57	1.26	5.0	50.9	10.7	40.2
24103-4b	Field #4, 3 – 6"	2.61	1.61	19.9	38.2	16.1	22.1
24103-5a	Track, 0 – 3"	2.58	1.04	4.9	59.8	11.3	48.5
24103-5b	Track, 3 – 6"	2.65	1.59	20.3	40.0	11.9	28.1
Desired				**> 6**	**40 - 60**	**15 - 30**	**15 - 25**

Well aggregated, flocculated soils

Dispersed or deflocculated

Elevated salts(EC_{se} = ~6.0) & sodium (438ppm)


08/16/2012

Poor infiltration, crusting, low oxygen

Foot traffic further eroding soil structure

Black Layer

Potable vs Recycled Water

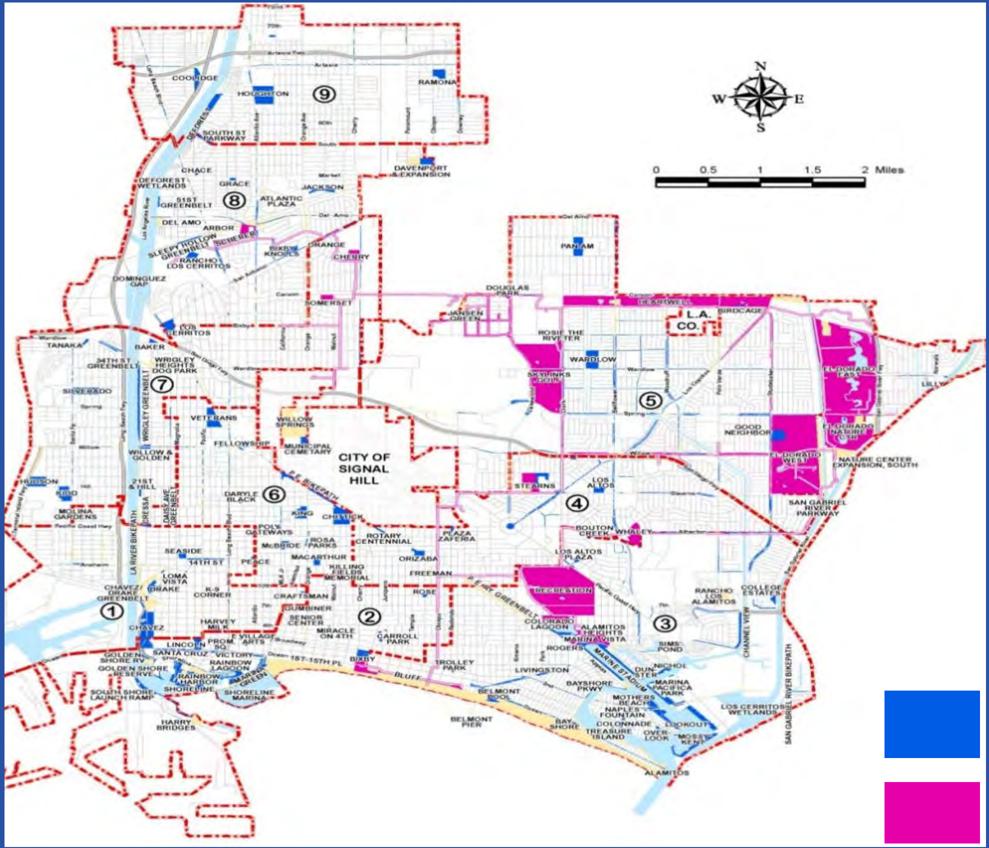
Constituent	Potable	Recycled	% Change
Nitrate (NO_3)	0.65	18.90	114
Phosphate (P_2O_5)	0.41	2.20	437
Potassium (K_2O)	12.02	45.90	282
Magnesium (Mg)	123.70	67.50	< 45 >
Calcium (Ca)	149.49	132.20	< 12 >
Sulfur (S)	181.43	332.10	83
Iron (Fe)	0.03	0.3	900
Sodium (Na)	189.15	415.80	120
Chloride (Cl)	254.05	604.80	138
Bicarbonate (HCO_3)	318.57	683.10	114
Total Sol. Salts	1549.31	1984.50	28
EC_w	0.89	1.6	---
pH	8.1	6.9	---

All constituents listed in lbs / A-ft water (325,851 gallons)

Solutions

- Leaching factors
  - A new management component will have to include living with less water
- Plant Selection
- Soils management
  - Cultivation
    - Aeration
  - Amendments
    - Inorganic (gypsum, etc) and organic
    - Fertility practices
      - Ion imbalances and testing

Long Beach by the Numbers



- Over 3,000 acres of parkland and open space in city
- Irrigate 1,275 acres of parks and street medians
- 54% or 687 acres irrigated with reclaimed water
- 46% or 588 acres irrigated with potable water

Potable Parks and Street Medians

Reclaimed Parks, Golf Courses and Street Medians

Leaching Requirement and Reclamation Leaching

How do we move the salts below the rootzone when using poor quality water?

1. Leaching Requirement (LR): application of enough water to maintain the current salinity, which is below the threshold for the plant
2. Reclamation leaching (RL): soil salinity levels are above the plant threshold and salts must be moved below the rootzone.
   - In the case of turf, yield will be effected which directly impacts playability, recuperative potential, etc

"I'LL HAVE SOME WATER MOLECULES WITH MY SALT ORDER, PLEASE"

Leaching Requirement

$LR = EC_w / 5\ EC_e - EC_w$

EC_w = salinity of water

EC_e = threshold salinity of the plant

Recycled water on a bermuda soccer pitch:

$$LR = \frac{1.6}{5\,(4.0) - 1.6} = 8.7\ \%$$

Potable water use on a bermuda soccer pitch:

$$LR = \frac{0.89}{5\,(4.0) - 0.89} = 4.7\ \%$$

Evapotranspiration and LR

Maintenance leaching – a couple of points to consider:

- ET or evapotranspiration – water lost from the plant / soil interface due to evaporation from the soil and transpiration from the plant.
- ET determines how much water needs to be added on a weekly basis to keep the plant in good condition.
- wwwcimis.water.ca.gov/cimis/

Ex: bermudagrass in September is 1.08” a week.

How much additional water is that?

For a 1.5 acre bermudagrass soccer pitch that requires 1.08 inches of water to re-supply the turf:

- Need about 44,000 gallons of water per week
- Adding an additional 8.7% = ~3900 gallons / field.
- If your field has 20 irrigation heads that each put out 20 gpm, 120 minutes total per week with +8.7%.
- Without LR you would need 110 minutes per week.
- Note – potable water (4.7%) would require an additional 2070 gallons to be added, or a total of 115 minutes per week.

Reclamation Leaching (RL)

Necessary when the level of salinity greatly exceeds the threshold for the plant

- $$D_w = \frac{k \times D_s \times (EC_{eo} - EC_w)}{Ec_e - Ec_w}$$

D_w = depth of water to apply (ft)
K = .1 (factor)
D_s= .5 (depth of leaching in feet)
EC_{eo} = current salinity reading (6 dSm^{-1})
EC_w = salinity of water source (1.6 dSm^{-1})
EC_e = final soil salinity desired (4.0 dSm^{-1})

- D_w = .092 ft of water (1.1 inches) or 44,804 gallons is needed to move the salts ½ foot deep in the profile when using using recycled water.

Reclamation Leaching vs. Leaching Req’t

LR = 3900 gallons more per week using *recycled water*

LR = 2070 gallons more per week using *potable water*

RL = 44804 gallons more per leaching cycle with recycled

RL = 40188 gallons more per leaching cycle with potable

Both function to alleviate the additional soluble salts and sodium (calcium first) that can build up in the rootzone.

Plant Selection

Turf is highly versatile

- Tolerates regular pruning, fibrous root system lends itself to durability, large capacity to absorb carbon, and vegetative cover provides for efficient cooling of the environment
- Functional Quality – includes resiliency, yield, rooting, and recuperative potential
- Visual Quality - includes density, uniformity, smoothness

Dr. Roch Gaussoin, University of Nebraska

Turfgrass Salinity Tolerance

Common Name	General Tolerance	Threshold Tolerance	Grass Type
Alkaligrass	VT-T	8.5	Cool
Saltgrass	T	8.0	Warm
Kikuyu	T	8.0	Warm
Fairway wheatgrass	T	8.0	Cool
St. Augustinegrass	T	6.5	Warm
Tall fescue	T	6.5	Cool
Perennial ryegrass	T	6.5	Cool
Slender creeping red	T	6.3	Cool

Carrow and Duncan 2012

Common Name	General Tolerance	Threshold Tolerance	Grass Type
Buffalograss	MT	5.3	Warm
Blue grama	MT	5.2	Warm
Hard fescue	MT	4.5	Cool
Common Bermudagrass	MT	4.3	Warm
Hybrid Bermudagrass spp.	MT	3.7	Warm
Creeping bentgrass	MT	3.7	Cool
Kentucky bluegrass	MS	3.0	Cool
Zoysiagrass	MS	2.4	Warm

Field Scout Direct Soil EC Meter

Field Scout TDR 300 Soil Moisture Meter

https://www.youtube.com/watch?v=UYgl6xPxVJk

Trimble GPS

Soil Management

- Mechanical cultivation
  - Core aeration, vertical slicing, drill and fill
- Amendments
  - Chemical cultivation
- Nutrition
  - Imbalances caused by nutrient loading in the soil can be difficult to change
- Soil / Water test frequency
  - Determine variability in water source
  - Evaluate the effectiveness of the program
  - Soil: pH, Melich III, and saturated paste extract for salts

Drill and Fill

Variability in spacing of holes will influence up to 30% volumetric change of soil profile

Key Point Summary

- Soil physical properties provide porosity for plant management
- Recycled water is higher in sodium, and in general salts
- Sodium is especially problematic due to destabilization of the aggregate and related porosity destruction

Key Points - Solutions

- Solutions include:
  - Leaching requirements (LR) and reclamation leaching (RL) are tools to move water and ions through the profile using salty water.
  - Plants have salt tolerance ratings
    - Turf tends to be highly desirable from this standpoint
  - Soil management
    - Mechanical cultivation
    - Calcium has to be a solution if sodium levels are elevated
    - Nutritional balance
      - Soil and water testing

Questions

Kelly Parkins
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References

- Ayers, R.S., and D.W. Westcot. 1994. *Water quality for agriculture* (FAO Irrigation and Drainage Paper, 29, Rev. 1). Rome: United Nations Food and Agricultural Organization.
- Carrow, R.N., and R.R. Duncan. 2012. Saline and Sodic Turfgrass Soils. CRC Press, Baca Raton, FL.
- Brady, N.C. and Ray R. Weil. 2008. The Nature and Properties of Soils. Pearson Prentice Hall.
- Tanji, K. et al. Salt Management Guide for Landscape Irrigation with Recycled Water in Coastal Southern California. A Comprehensive Review.
- Horneck, D.A. et al. 2007. Managing Salt Affected Soils for Crop Production. Pacific NW publication.
- Stowell, L.J., and W. Gelernter. 2001. Negotiating reclaimed water contracts: Agronomic considerations. *Pace Insights* 7 (3): 1-4. San Diego, CA: PACE Consulting.