ITRC

moving water in new directions

BRAE

bioresource and agricultural engineering

Irrigation Training and Research Center

Center of Excellence

BioResource and Agricultural Engineering (BRAE) Department

ITRC

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**

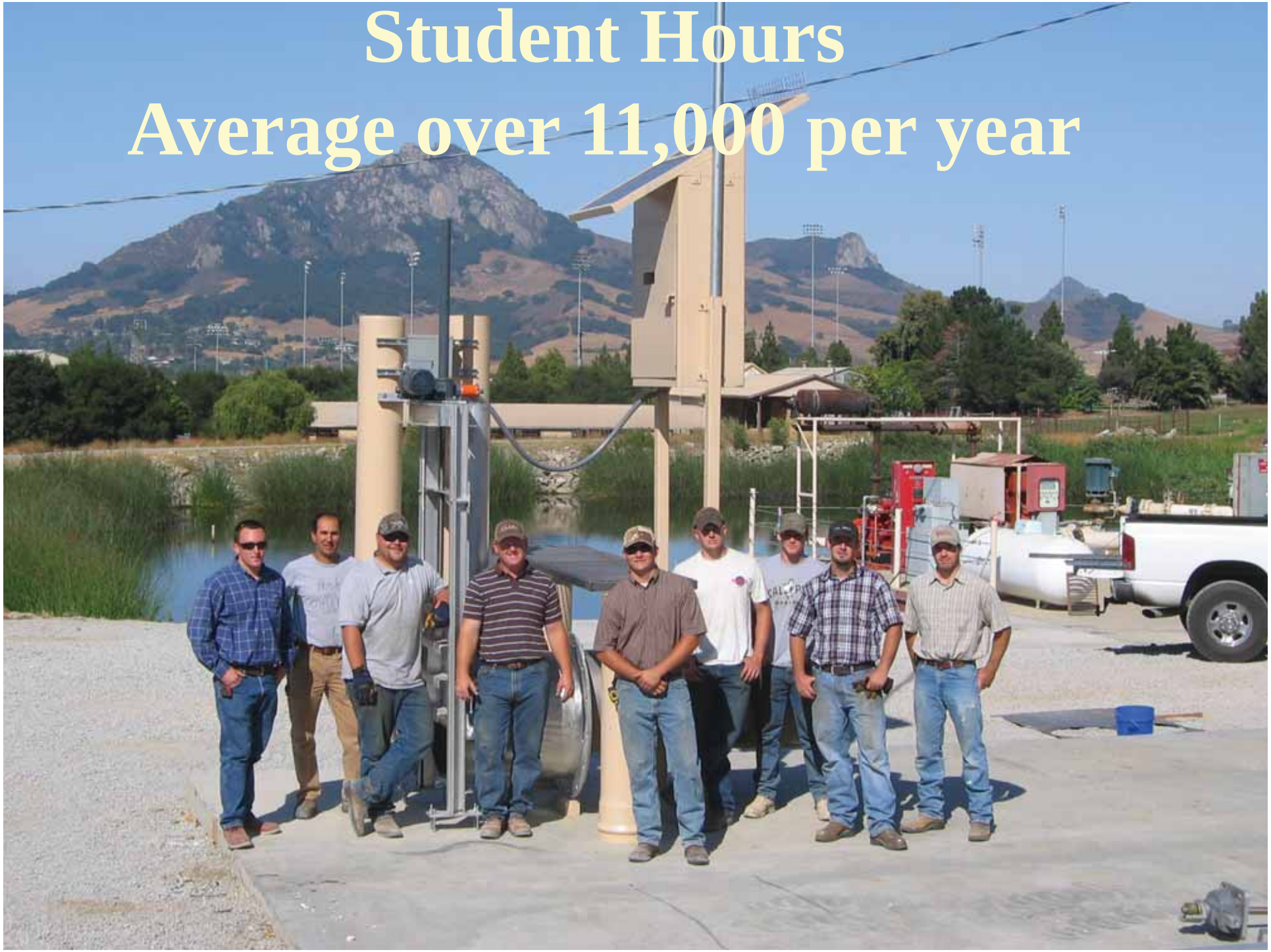
ITRC

moving water in new directions

Facilities

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

Student Hours
Average over 11,000 per year



California Agricultural Irrigation Dealers examining drip filter backflushing

ITRC
moving water in new directions
Irrigation Training and Research Center

CAL POLY
AGRICULTURE

BRAE

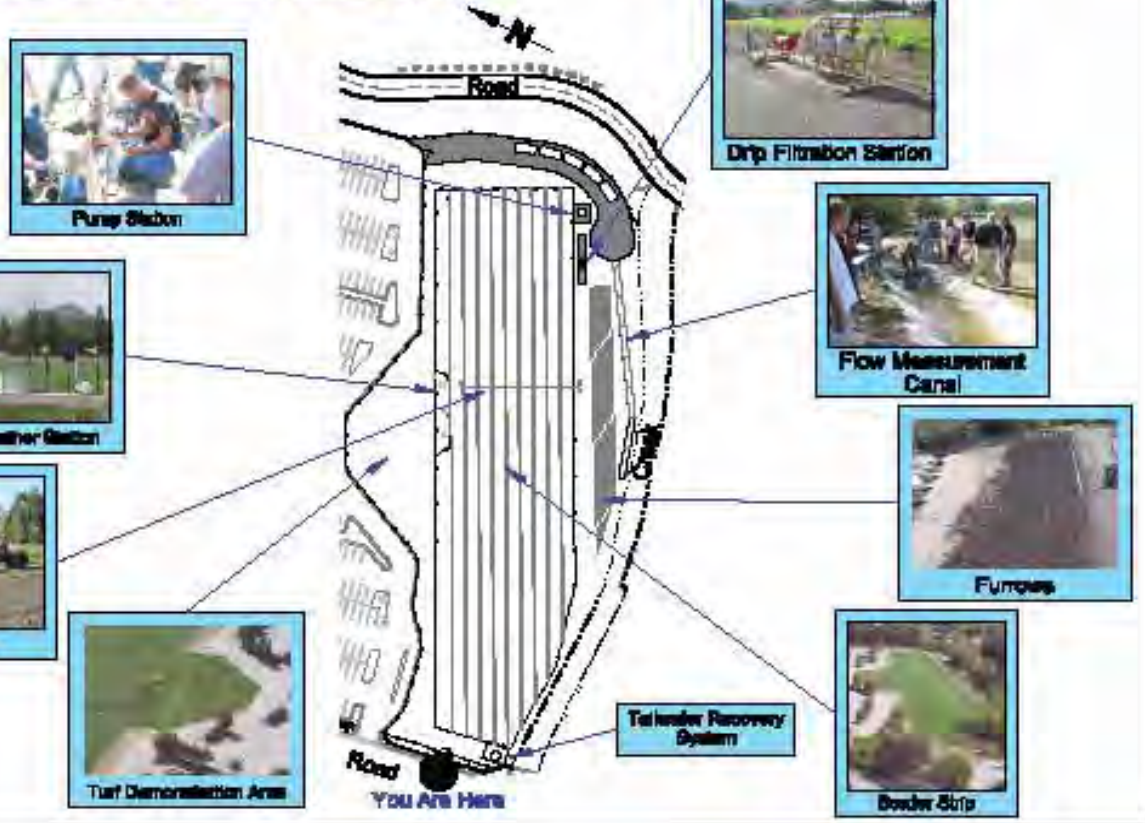
John L. Merriam

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



ITRC

– Irrigation Training and Research Center

Specialties

- Modernization of districts
- Automation, SCADA
- Efficiency, uniformity
- Water balances, ET, Salinity
- On-farm irrigation methods
- Landscape water conservation

ITRC Activities

Research and Testing – 25%

Training – 10%

Technical Assistance – 65%

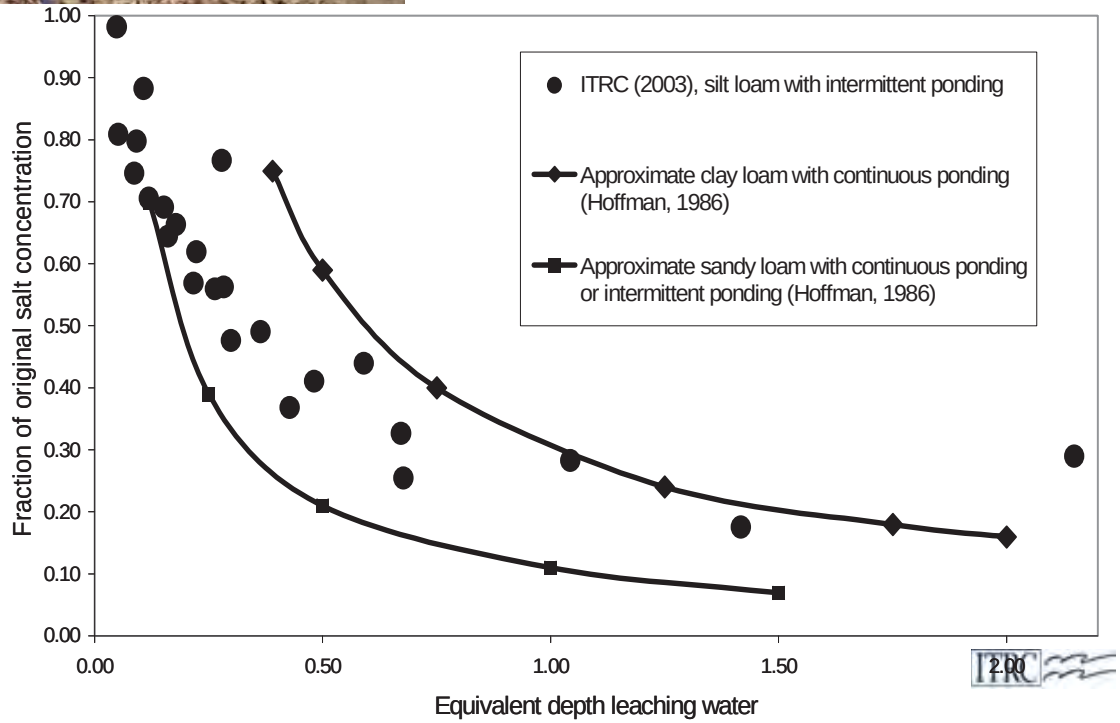
ITRC funding

- **No support $$ from the University.**
- **ITRC funds 95% of improvements and maintenance for outdoor facilities.**
- **ITRC pays all salaries, phone, cleaning, equipment, paper, vehicle…..etc. ITRC built our own offices.**
- **ITRC pays "overhead "to University**

Research Projects:

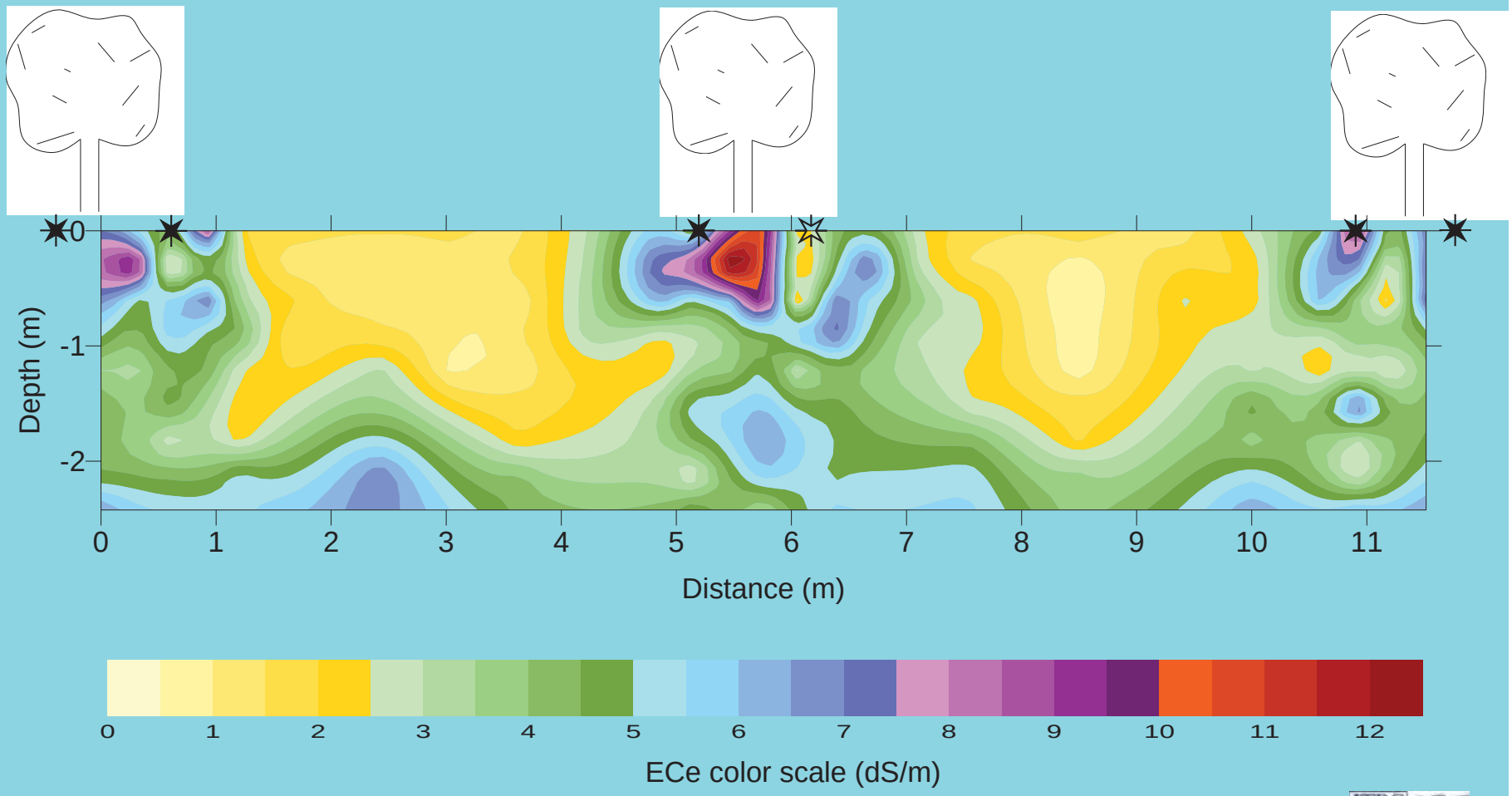
Salt accumulation under drip irrigation

Salt leaching



Research - Long term salinity buildup on the West Side of the San Joaquin Valley

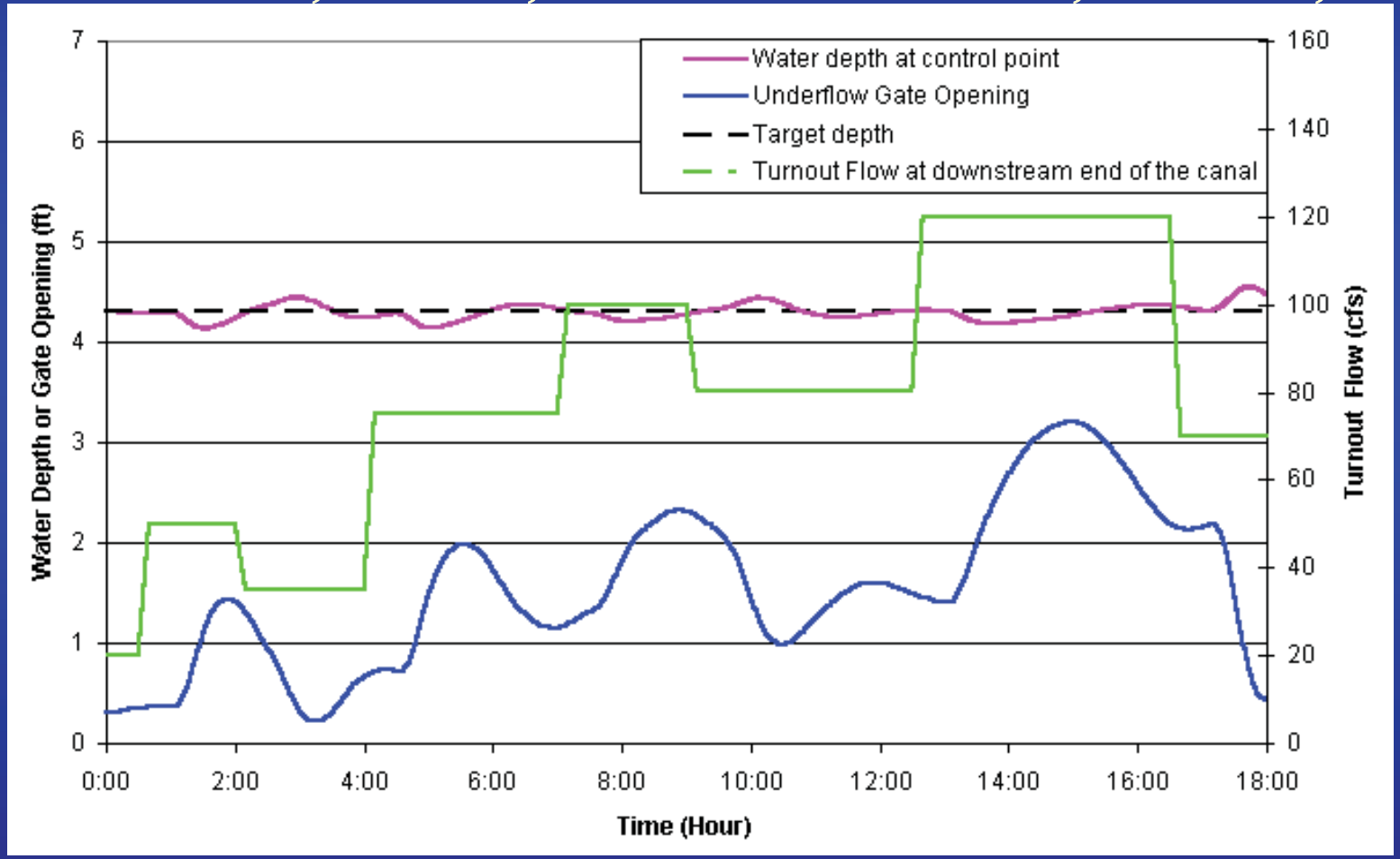
DRIP irrigation



ITRC

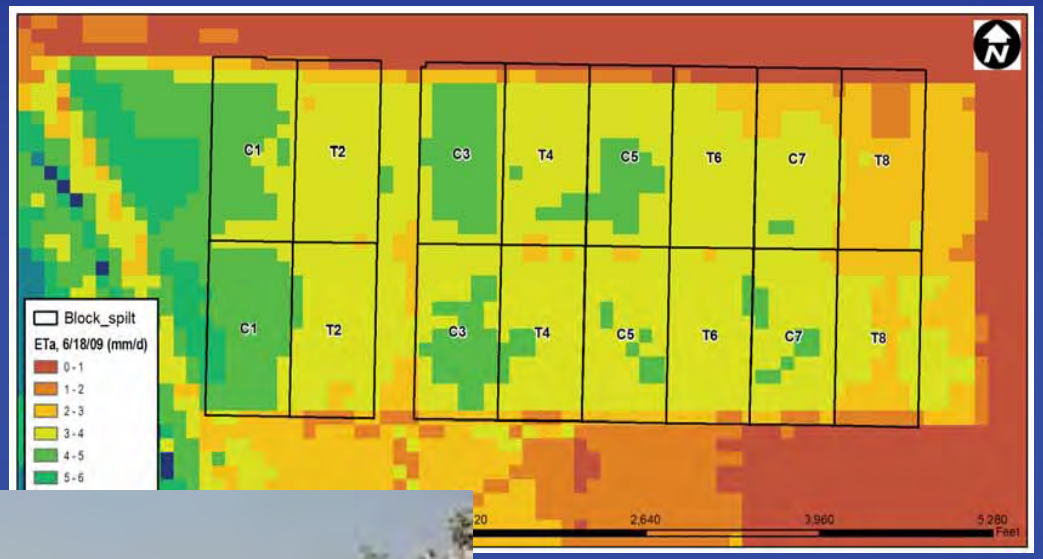
Canal Automation - PIF

Patterson ID, Tulare ID, RD 108, CCID, GVWUA,
W. Stanislaus ID, James ID, Stanfield-Furnish Branch, Port. Bend, etc.



Algorithms, tuning, modeling, implementation……very successful.

Research – ET reduction of pistachios with Kaolin spray

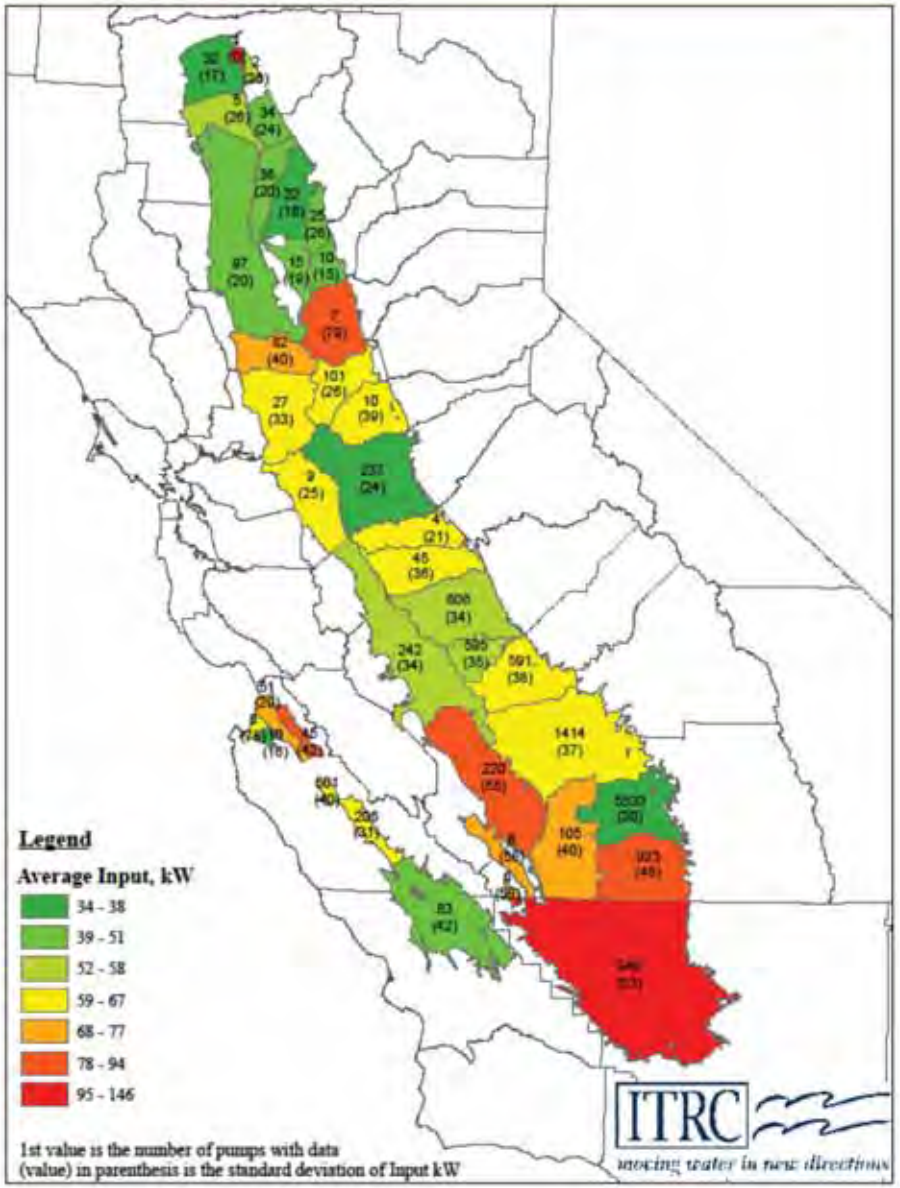


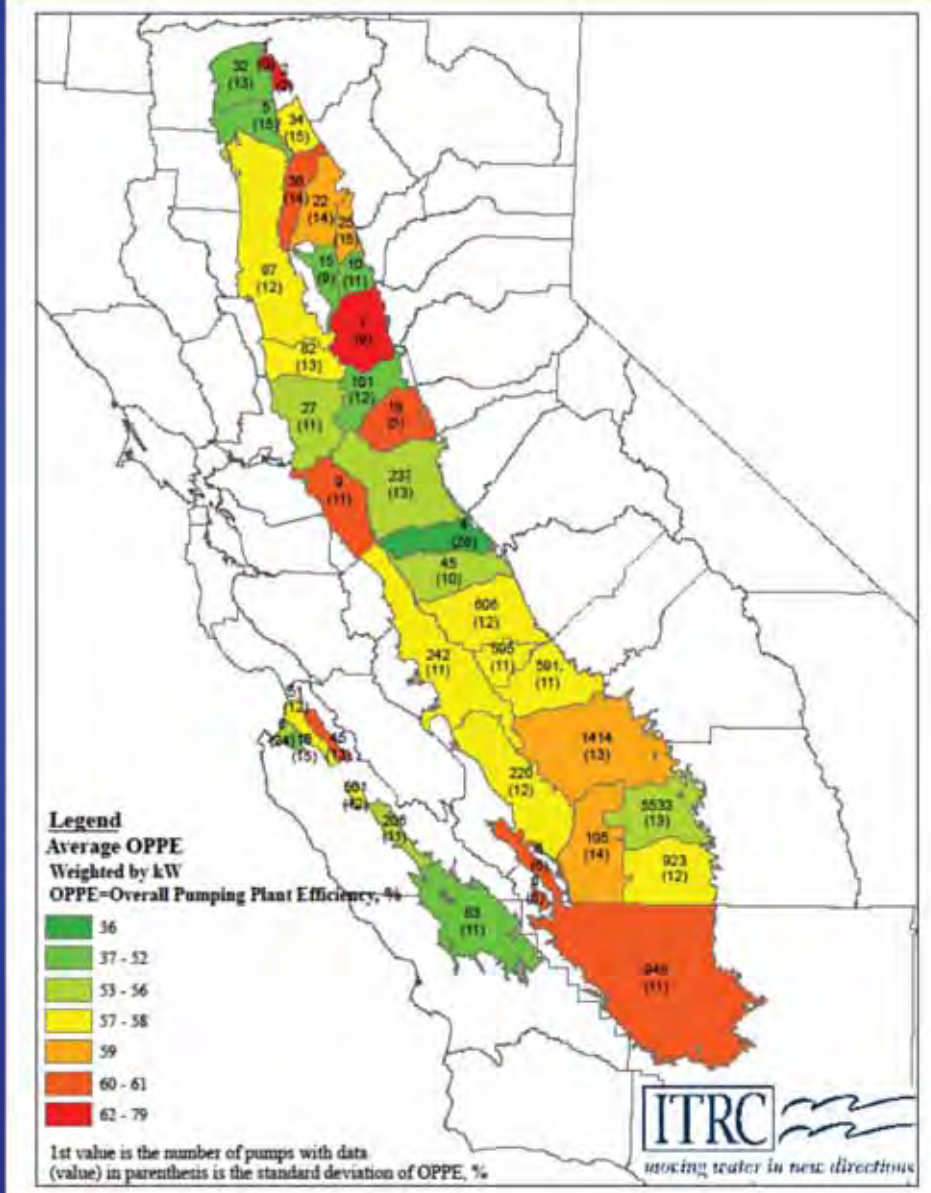
Research – Canal Seepage Reduction

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**

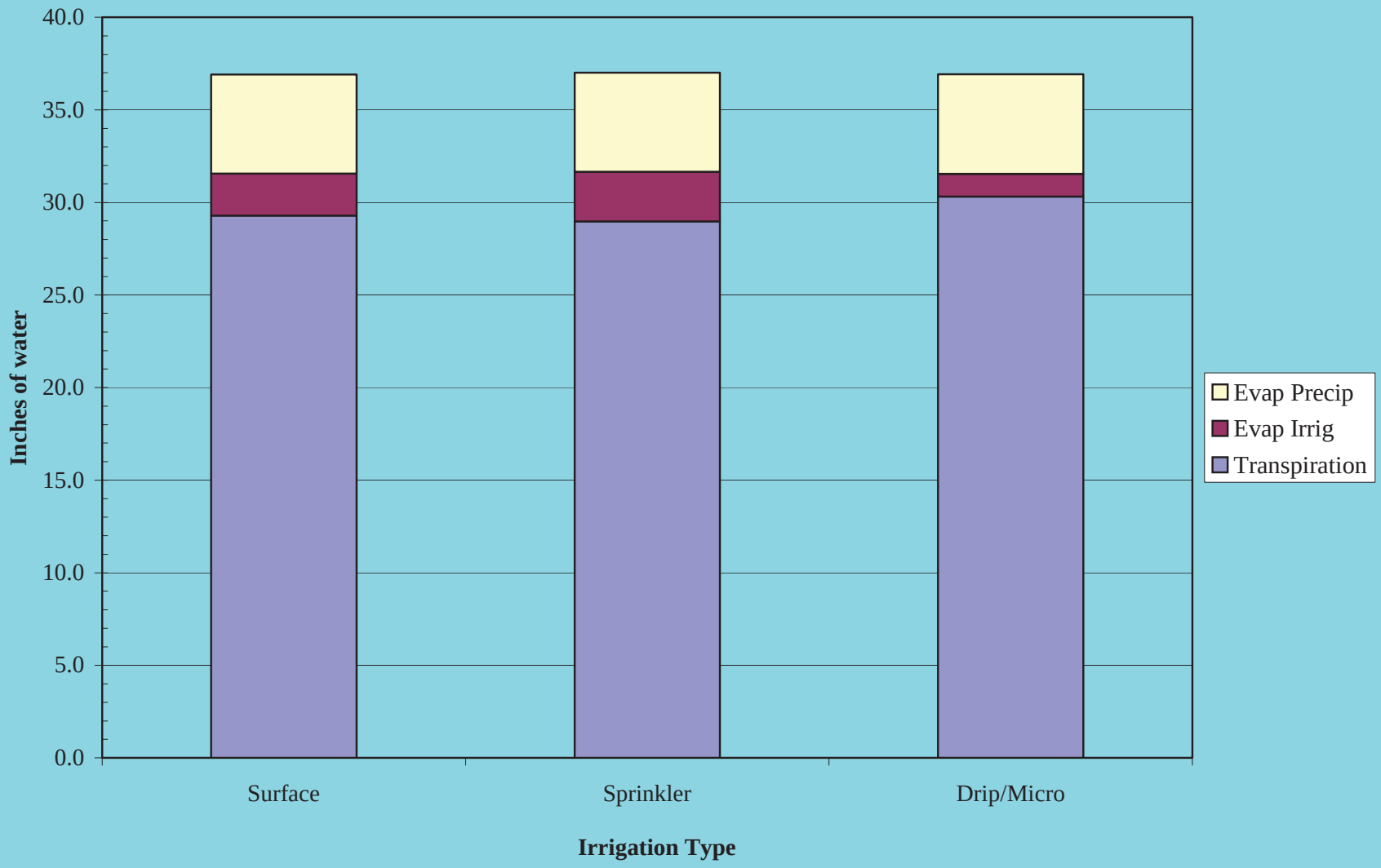
ITRC

Research – Electrical Energy for Irrigation





Research - California Evaporation



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

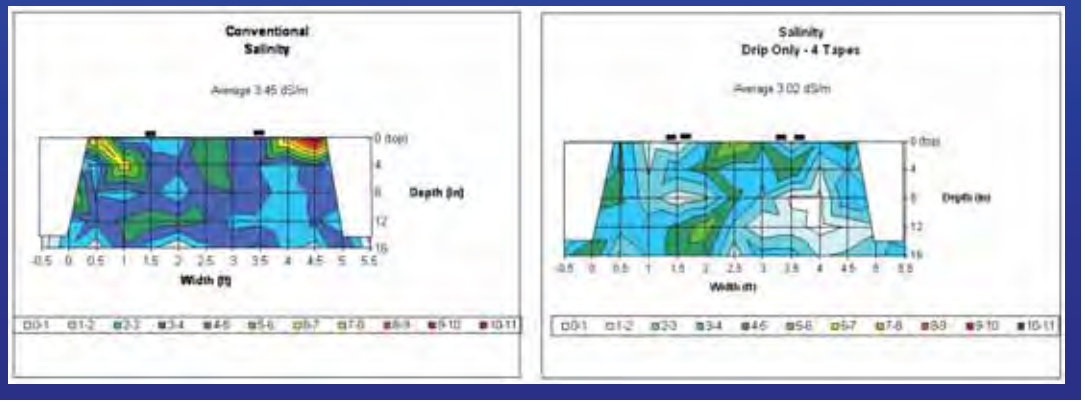
Main Issues:

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

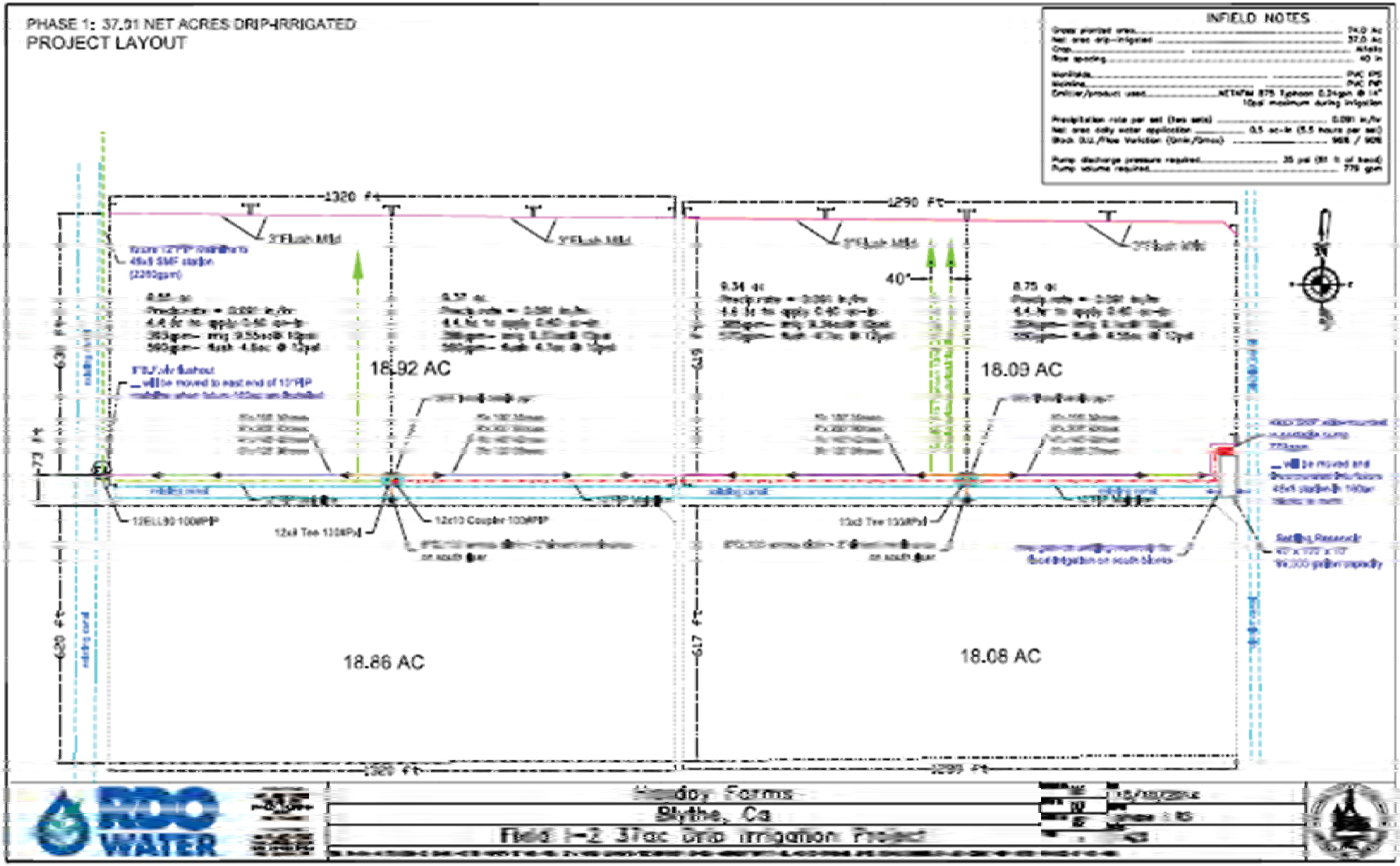
Keys to Implementation:

- 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

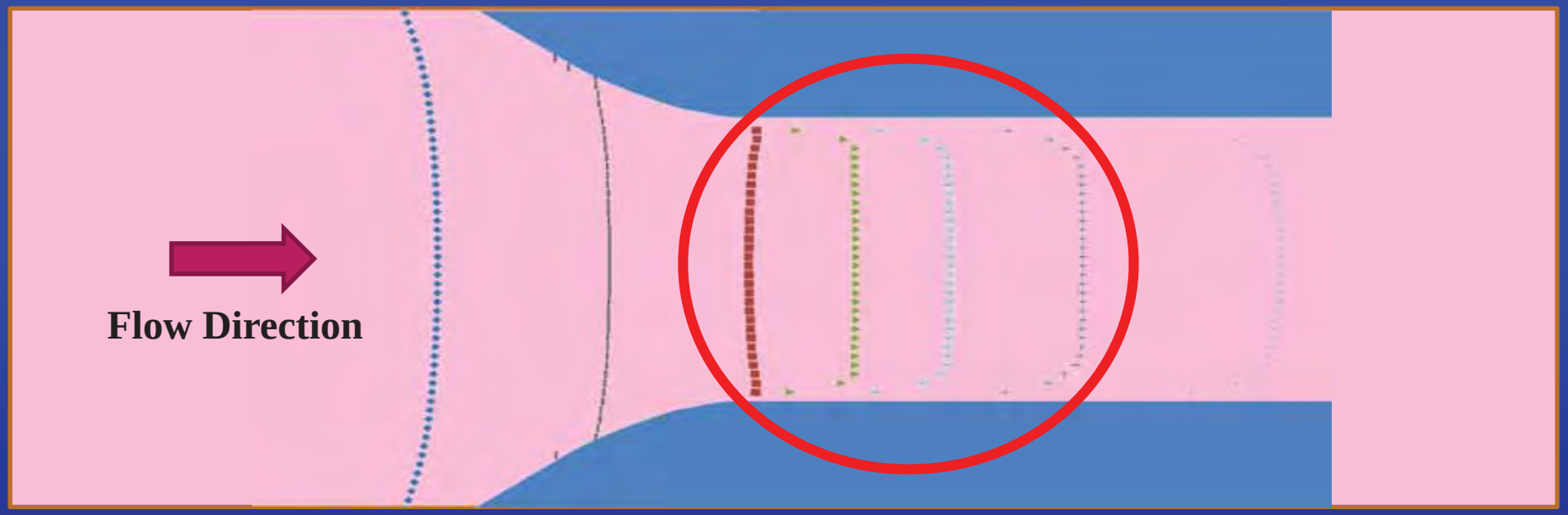


Evaluation of Drip on Alfalfa – HayDay Farms - Blythe CA



Research – “Flow conditioning” for acoustic doppler velocity flow meters

Create Uniform Velocities for ADVM measurement, to minimize or eliminate calibration requirements.



Prototype for Testing

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!

ITRC

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

ITRC

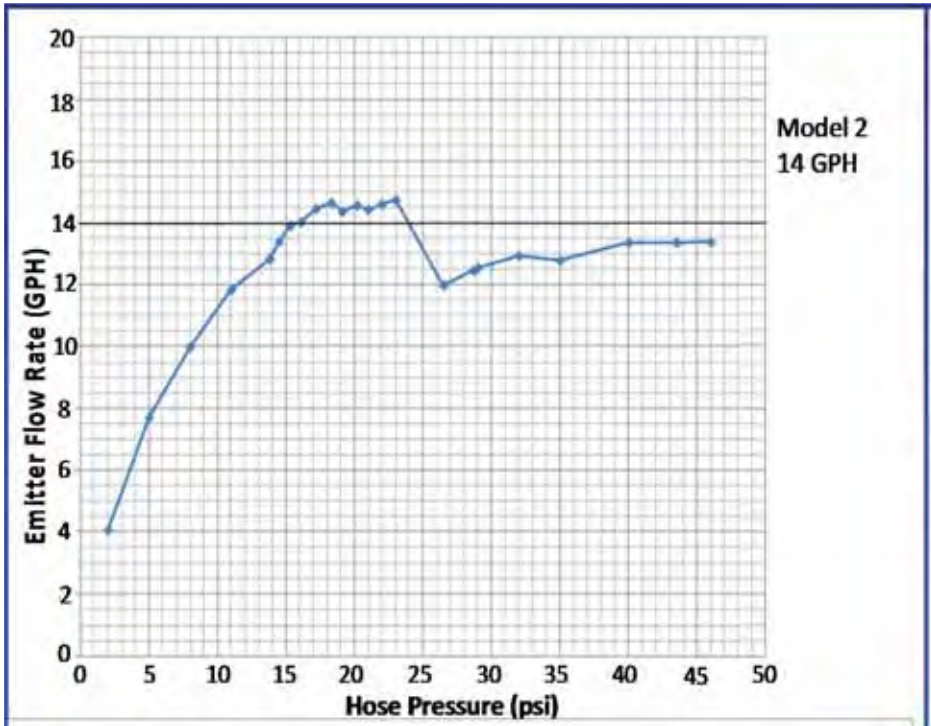
How about PC emitters?

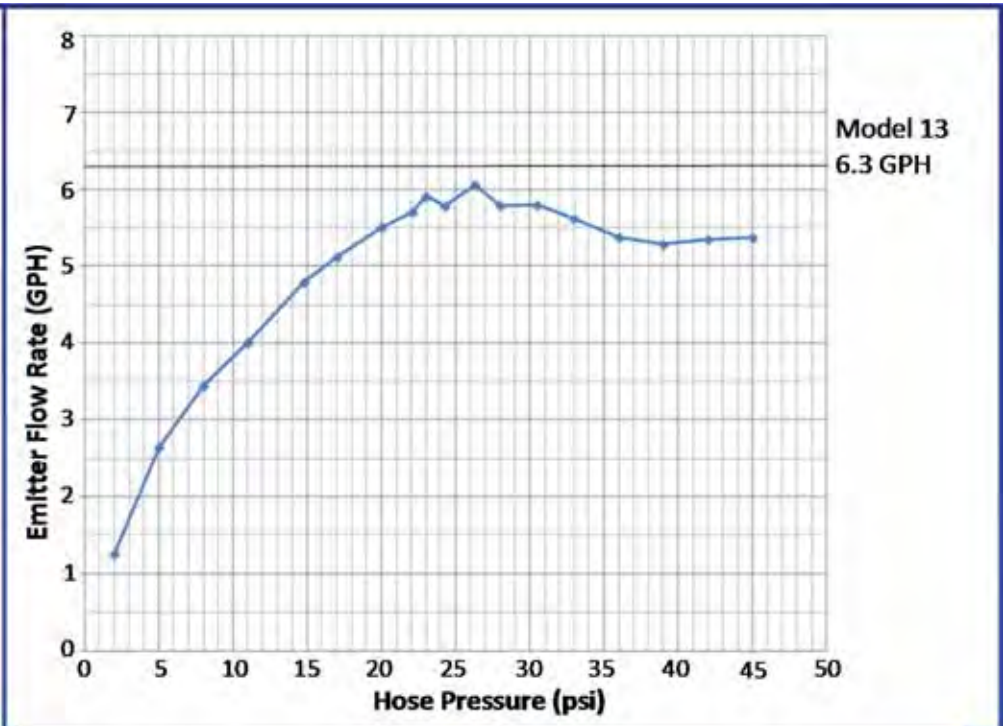
Most PC emitters today are high quality.

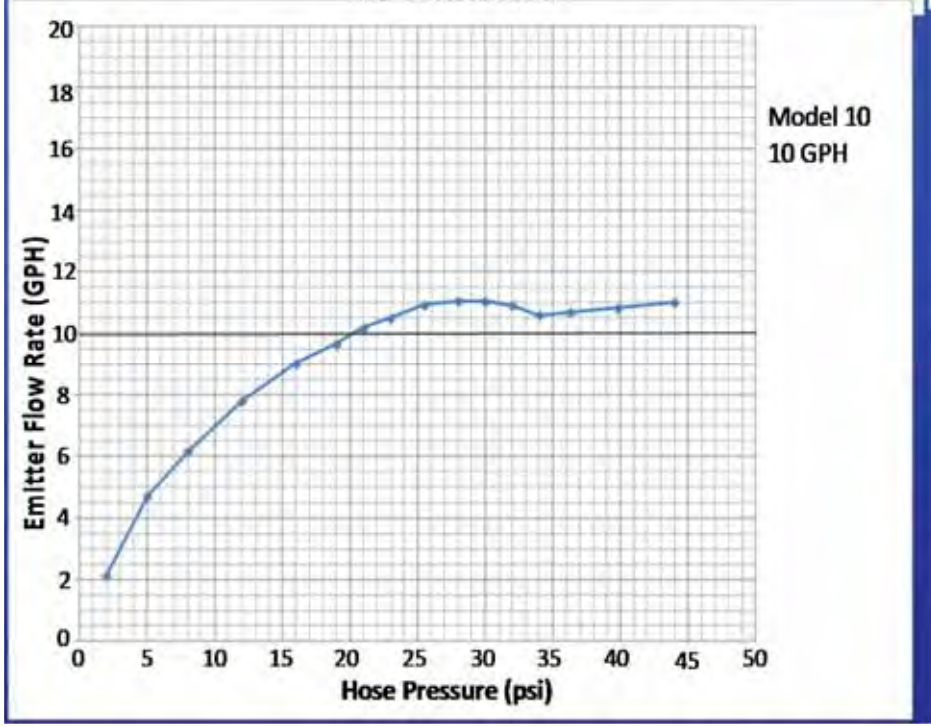
How about PC microsprayers?

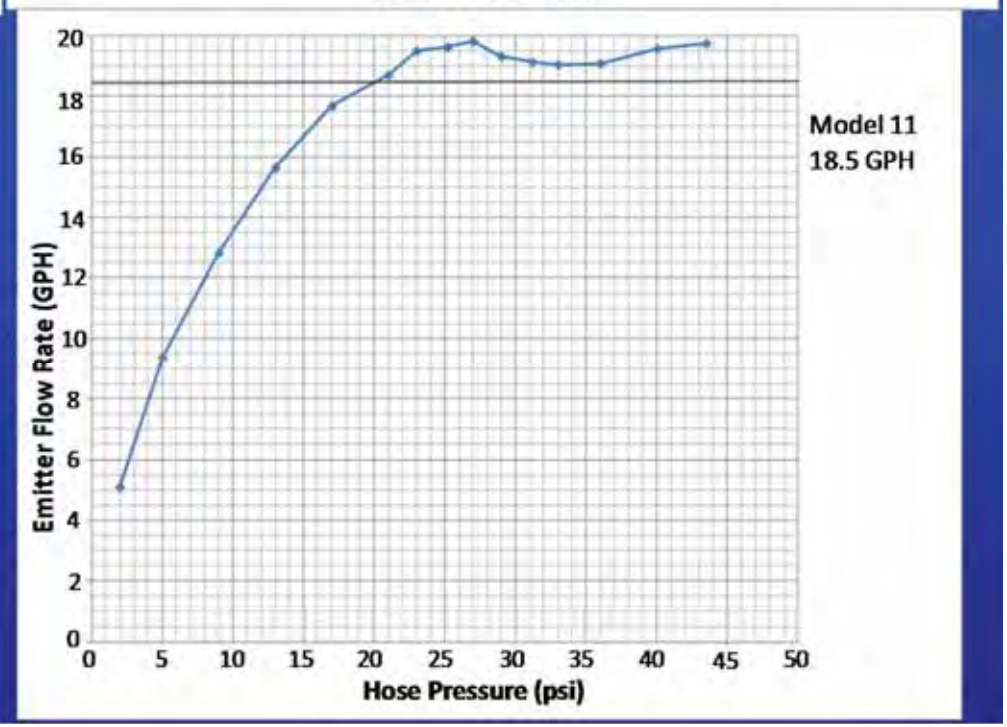
They aren't nearly as good as the low flow PC emitters.

- **High pressure requirements.**
- **Varying flows with pressure changes.**
- **Often the flow isn't the nominal flow.**


Emitter Flow Rate (GPH)
Hose Pressure (psi)
Model 2
14 GPH


Emitter Flow Rate (GPH)
Hose Pressure (psi)
Model 13
6.3 GPH


Emitter Flow Rate (GPH)
Hose Pressure (psi)
Model 10
10 GPH


Emitter Flow Rate (GPH)
Hose Pressure (psi)
Model 11
18.5 GPH

Sand Wear Testing

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 (Hydrotec), 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.

ITRC

Training

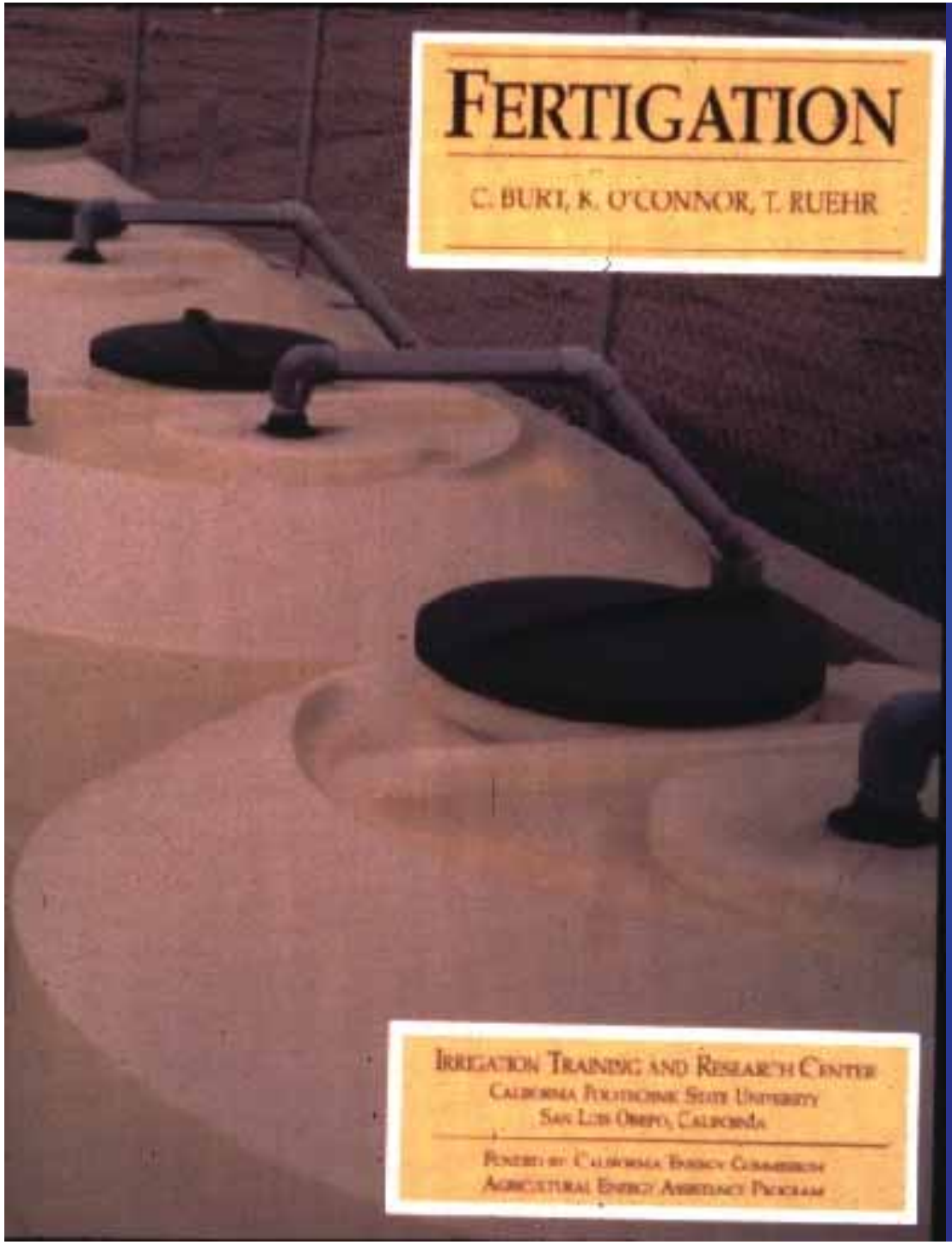
- **Designer/Manager School of Irrigation**
  - Summer
  - On-farm
  - Multiple, 1-3 day classes
- **Irrigation District School of Irrigation**
  - Winter
  - Flow measurement, canals, SCADA, etc.
- **Many custom, on-site classes**

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.

ITRC

Drip and Micro Irrigation Design and Management

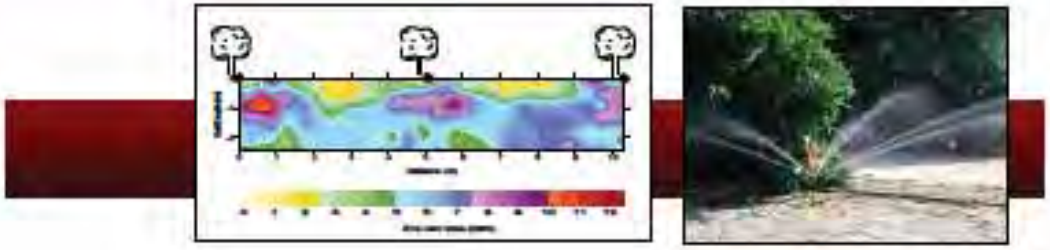
for Trees, Vines, and Field Crops

Practice plus Theory

4th Edition - 2011

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

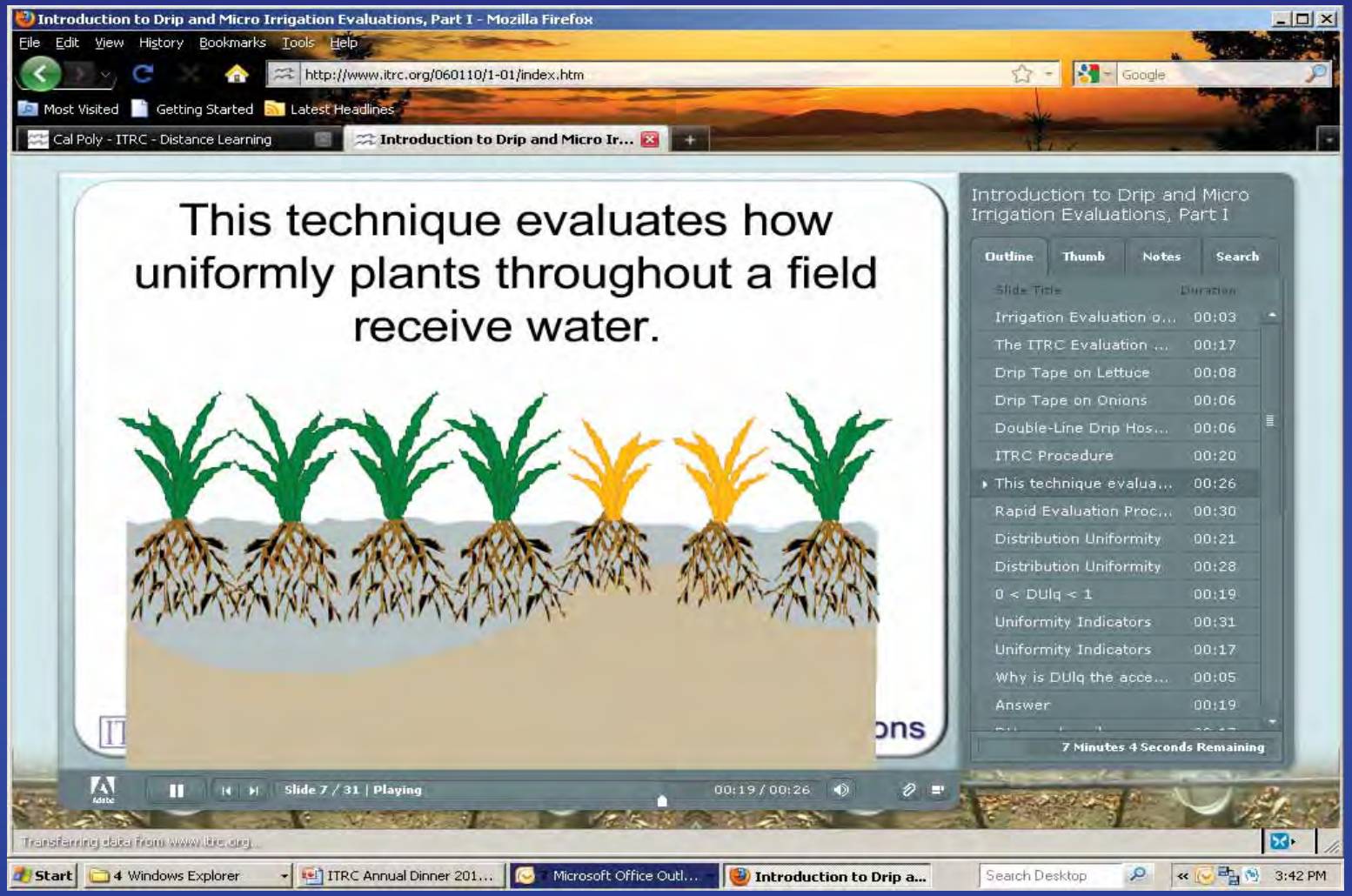
Irrigation Training and Research Center (ITRC)
BioResource and Agricultural Engineering (BRAE) Dept.
California Polytechnic State University (Cal Poly)
San Luis Obispo, California 93407-0730



The book used by The Irrigation Association.

Essential for training irrigation designers in California

ITRC

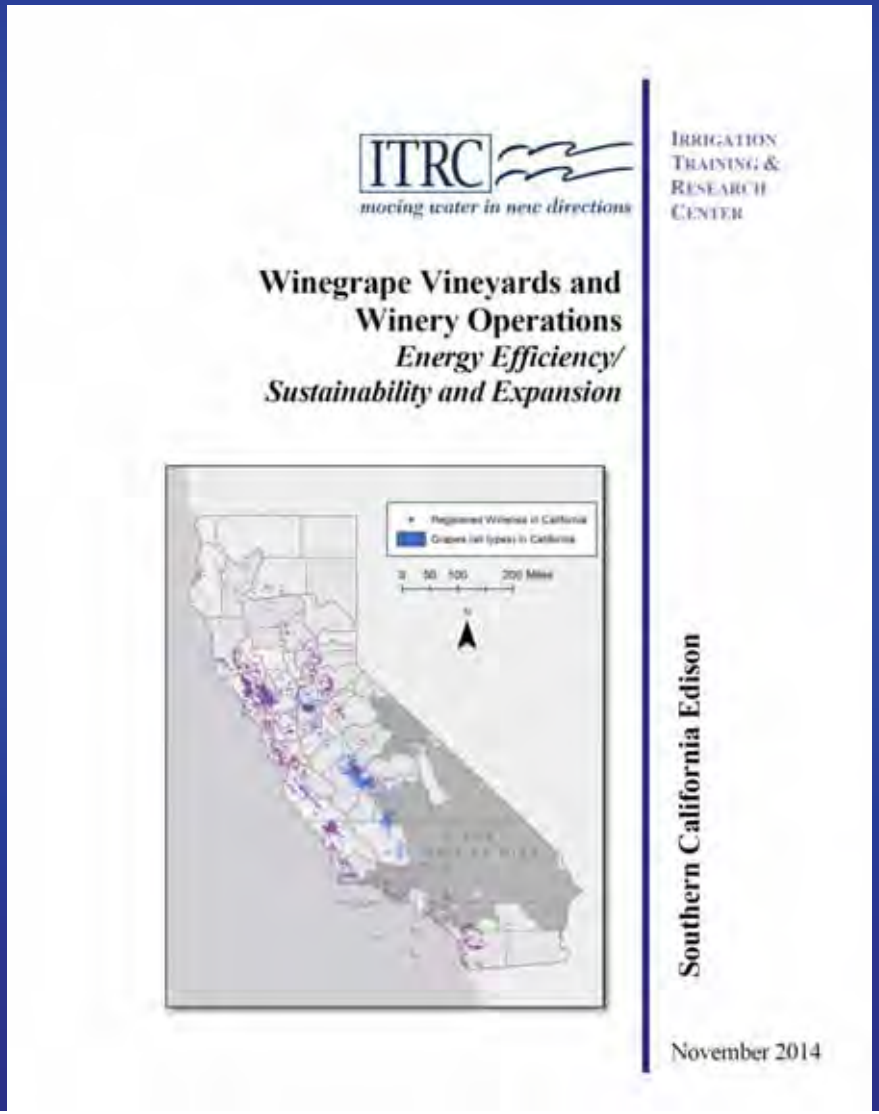


New web-based irrigation evaluation training modules

ITRC

DIRECT TECHNICAL ASSISTANCE

We do quite a bit on special studies, water rights cases, etc.




Peru Olmos Center Pivots
LandSAT 8 Image
4/24/2015
0 0.5 1 2 3 4
Miles
N
W
E
S

ITRC Water Projects in the Western US

Cal Poly ITRC

We can offer an excellent combination of pragmatic experience with theoretical backgrounds with expertise .

But….

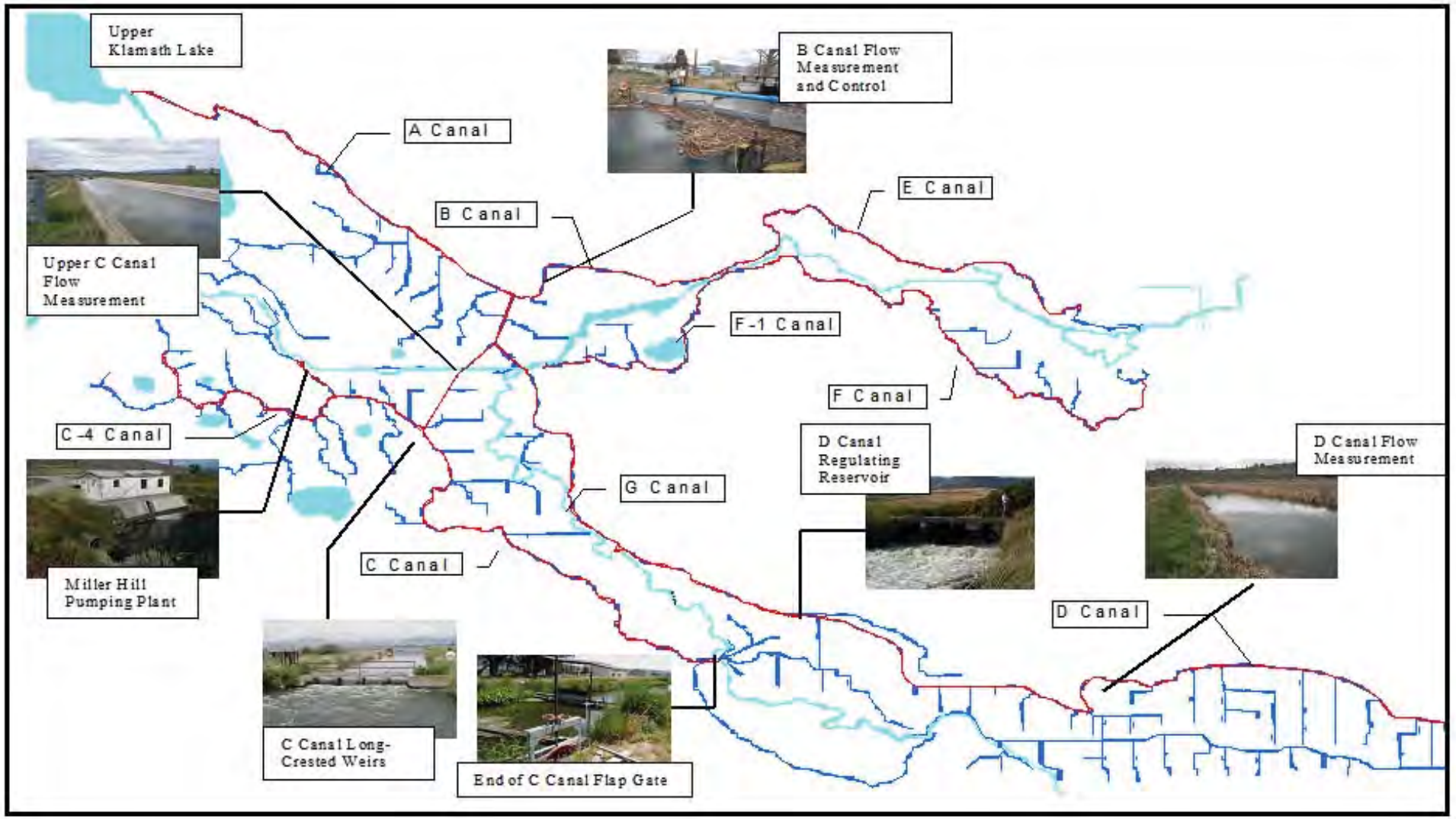
We are not subsidized.

A few more examples.

These are not research plots!!

BUT…we are hired because we continually push the envelope on innovation and new solutions……and because solutions work as promised.

Modernization plan – Klamath Basin



ITRC
moving water in new directions

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*

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moving water in new directions

IRRIGATION TRAINING & RESEARCH CENTER

Wind River Irrigation Project Modernization Plan

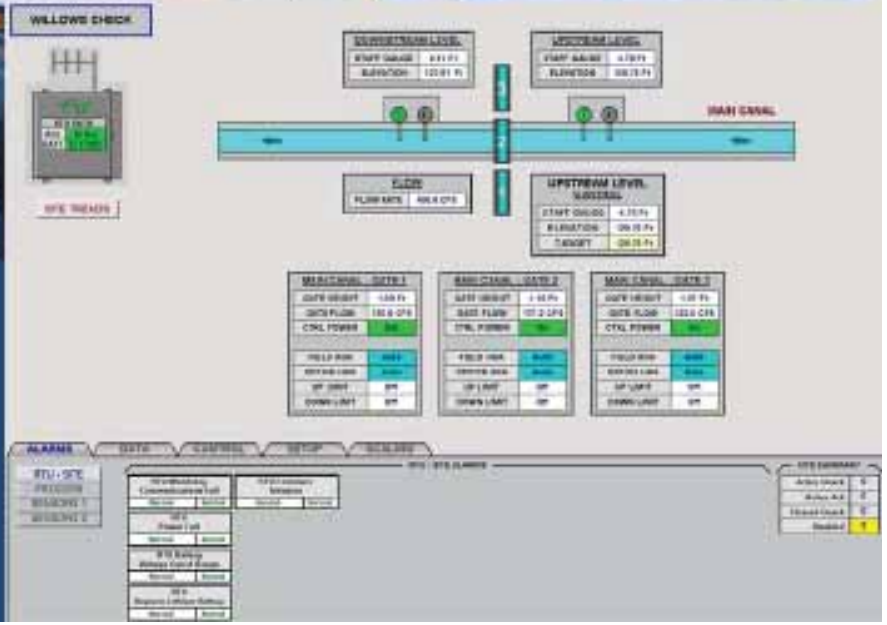
Modernization of the Sub-Agency and Lefthand Canal Units

U.S. Bureau of Indian Affairs
Branch of Irrigation and Power

April 2015

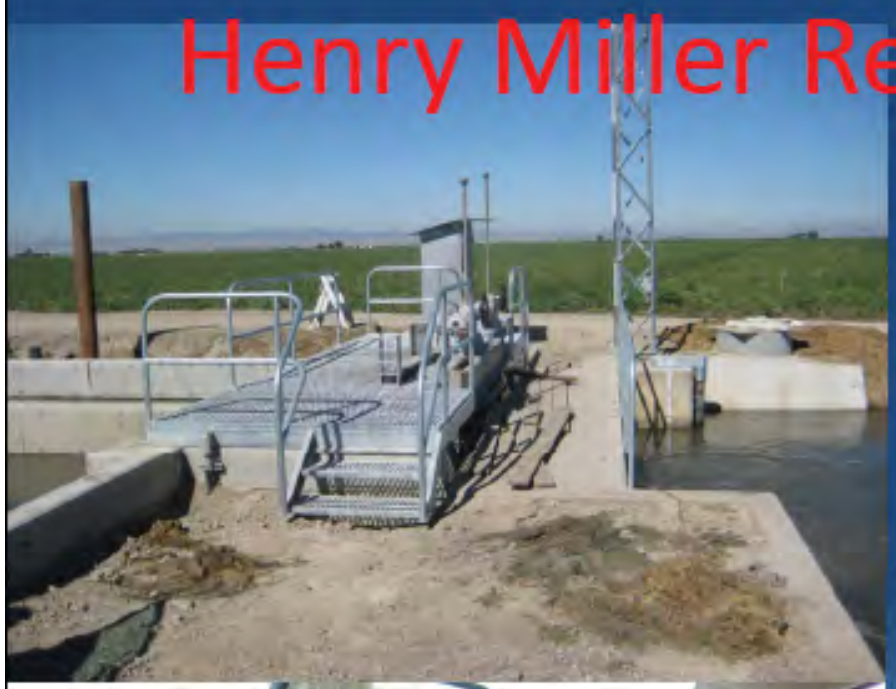
Technical Report

Glenn-Colusa ID



Modesto Irrigation District

Henry Miller Reclamation District




Roswell, New Mexico
Army Reveals It Has
Flying Disc Found On
Ranch In New Mexico

SCADA-Related Automation Projects - Examples

Central California Irrigation District (CCID)

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

ITRC

Providing districts with new options

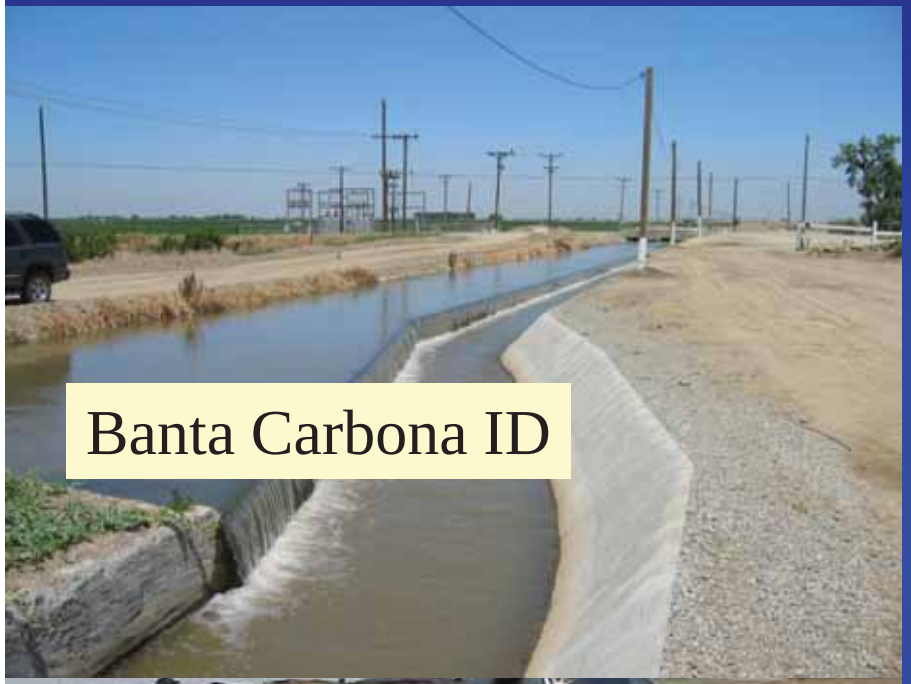
ITRC Flap Gate
Perhaps
300 in California.

ITRC FLAP GATE

District flow rate measurement

FLOW MEASUREMENT
To FIELDS

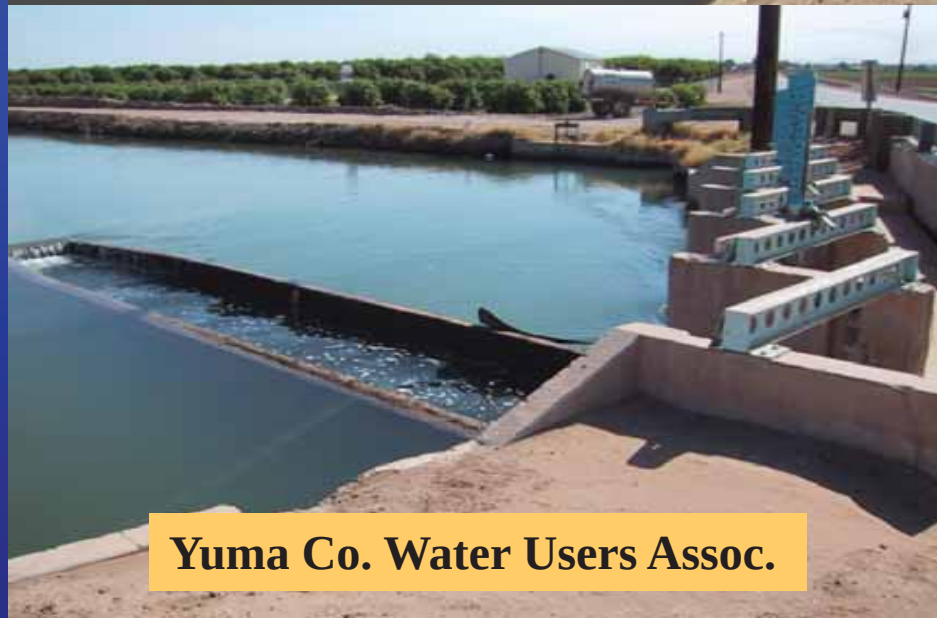
Long Crested Weirs for Water level control – Back to the Basics -



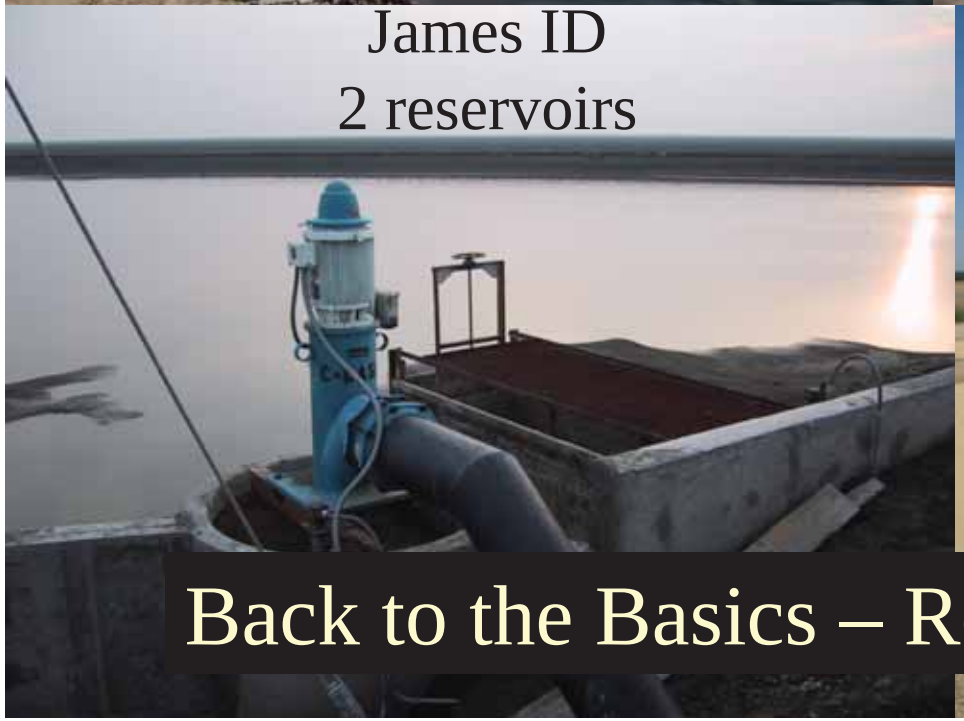
Banta Carbona ID

Patterson ID

San Luis Canal Co.



Yuma Co. Water Users Assoc.



Back to the Basics – Regulating Reservoirs

ITRC WEIR STICK (extremely basic)

Multi-Purpose:

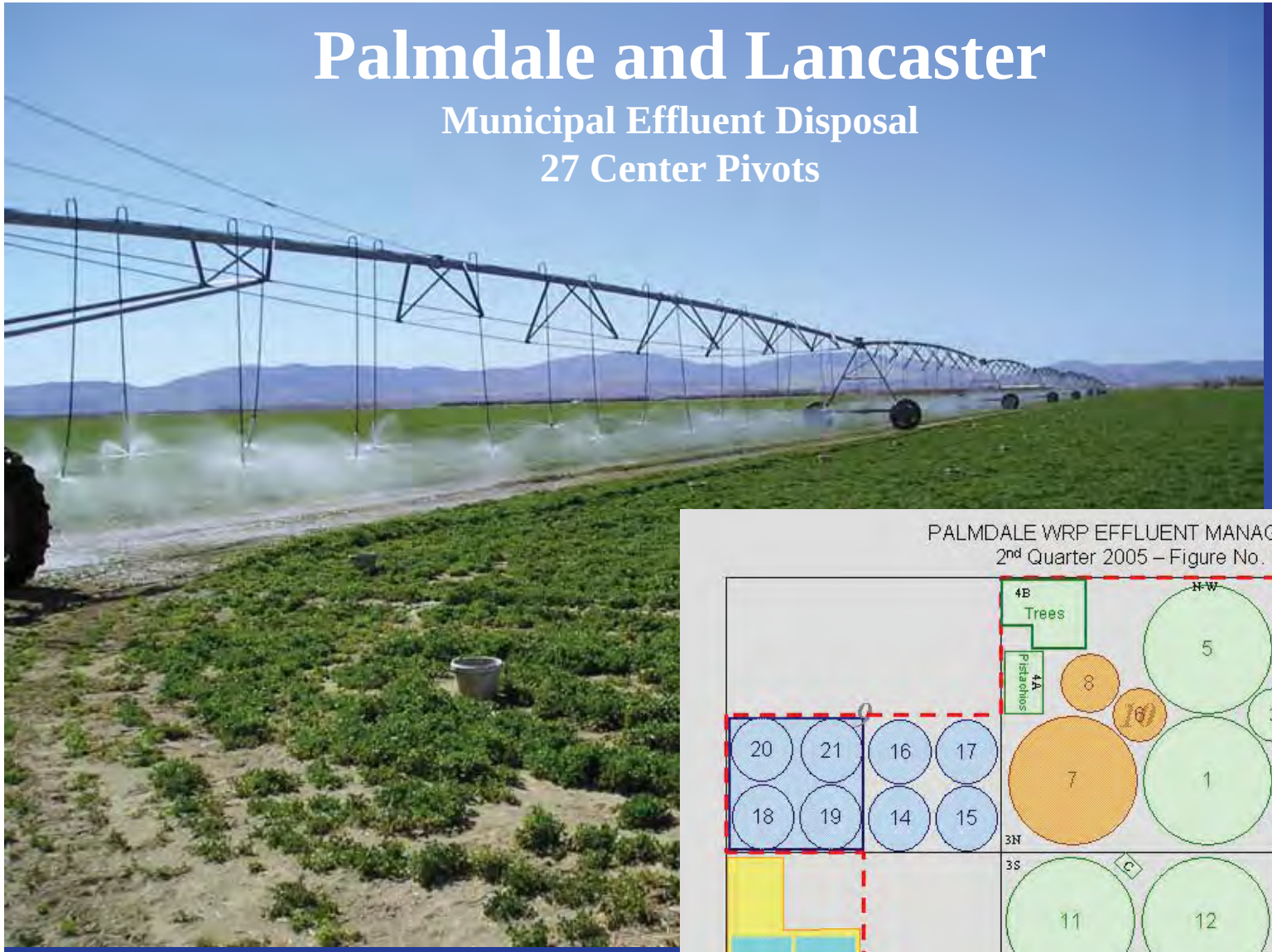
- Measure flow rate over a weir
- Pull boards
- Set boards
- Clear debris from water
- Walking support
- Animal defense stick

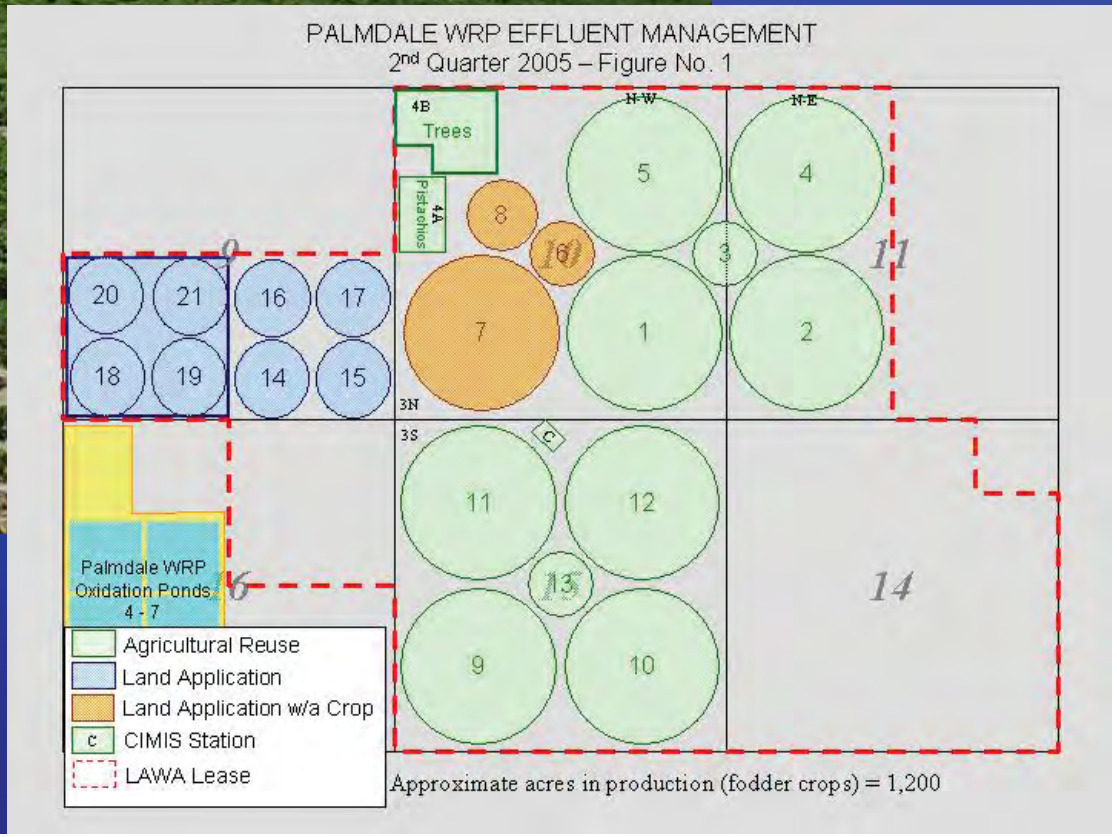
ITRC

Palmdale and Lancaster

Municipal Effluent Disposal

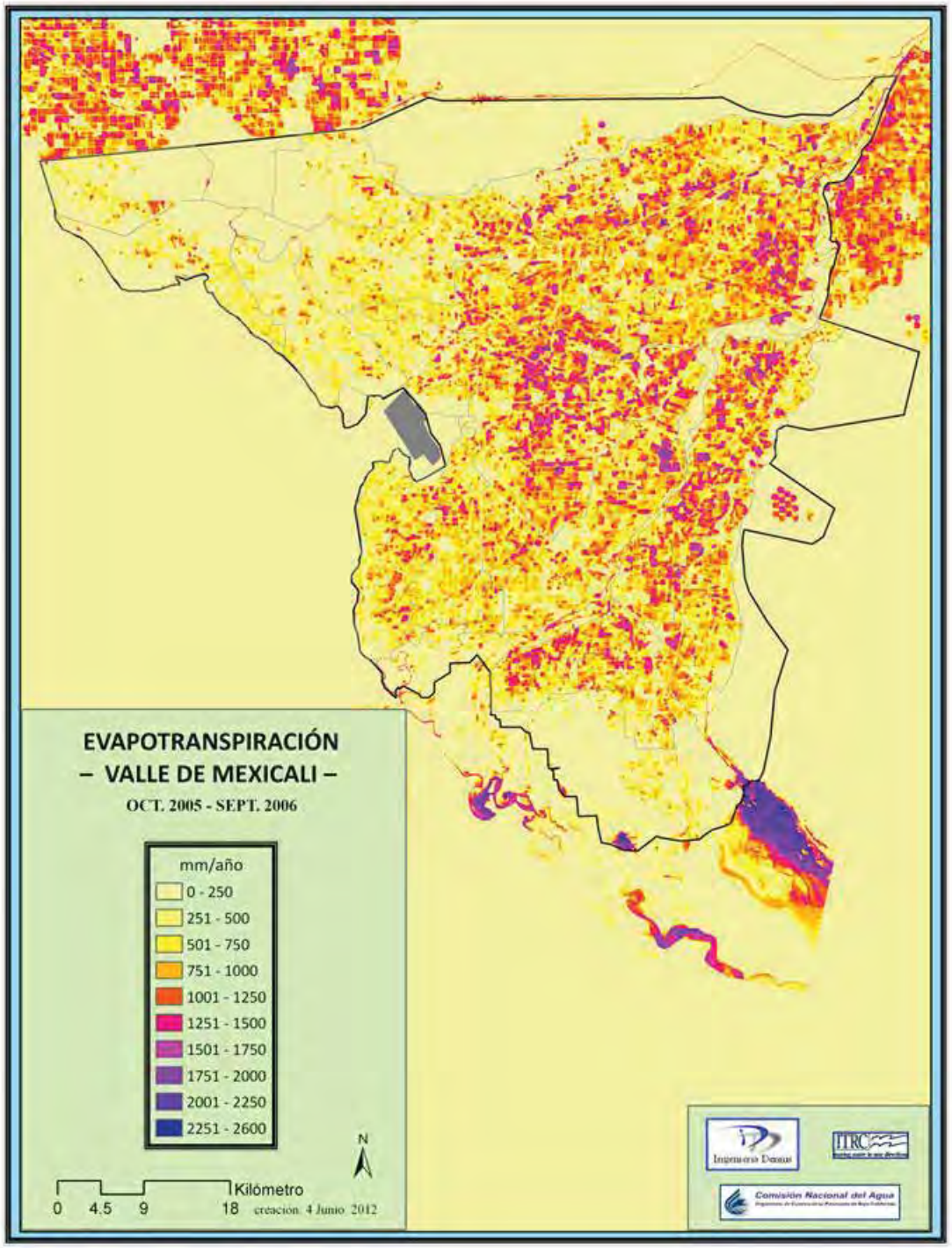
27 Center Pivots





Seismic design guidelines for irrigation canal design USBR Klamath, plus Mexicali Valley, Mex.


Rio Nuevo
Rio Alamo
Agua Subterráneo del Canal Todo Americano
NIB Presa Morelos
YUMA
MEXICALI
ET
Rio Colorado
Sanchez-Mejorada
Welton
Agua Subterranea de Yuma
Acueducto Tijuana
Canal Reforma
SAN LUIS R.C.
Rio Colorado
Welton
Dren Rito-Santa Clara
Rio Hardy
Dren Plan de Ayala
Ciénega de Santa Clara
Otros Drenes
Rio Colorado
Mar de Cortés
Agricultura
Cambio de almacenimiento del acuifero
Fuentes
Drene
Precipitación
ETagricola
ETambiental
ETotro



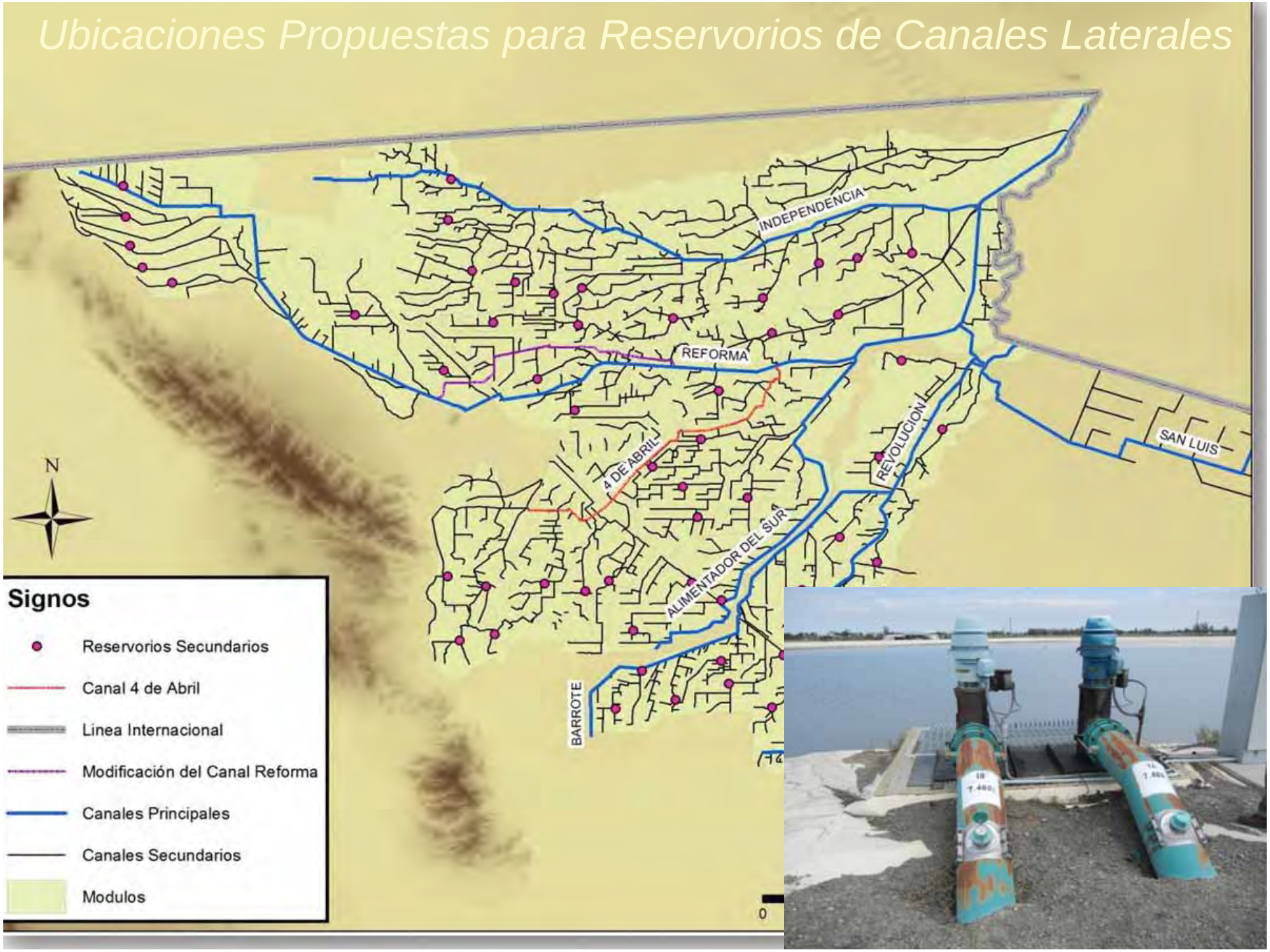
PLAN DE GRAN VISIÓN DEL AGUA DE BC

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

UEEP

IIRC

Ubicaciones Propuestas para Reservorios de Canales Laterales



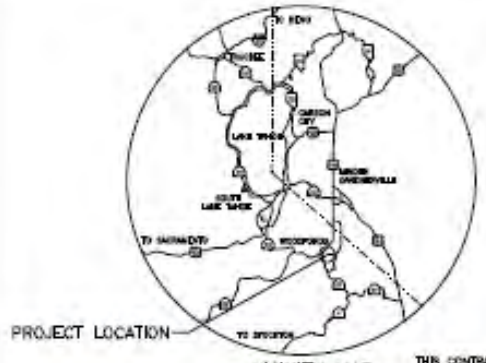
80% SUBMITTAL
FEBRUARY 2011

DIAMOND VALLEY RANCH

IRRIGATION IMPROVEMENTS PROJECT-PHASE 1

FEBRUARY 11, 2011

80% SUBMITTAL
COUNTY OF ALPINE
STATE OF CALIFORNIA



VICINITY MAP
NO SCALE

THIS CONTRACT REQUIRES COMPLIANCE WITH THE "BUY AMERICAN" PROVISIONS OF THE AMERICAN RECOVERY AND REINVESTMENT ACT

PROJECT LOCATION MAP
1"=1500'

ITRC
moving water in new directions

SOUTH LAKE TAHOE PUBLIC UTILITY DISTRICT
BOARD OF DIRECTORS

DALE RISE, PRESIDENT
MARY LOU MOSBACHER, VICE PRESIDENT
CHRIS CEFALU, DIRECTOR
JAMES R. JONES, DIRECTOR
ERIC SCHAFER, DIRECTOR

GENERAL MANAGER
RICHARD SOLBRIG, P.E.

SOUTH LAKE TAHOE PUBLIC UTILITY DISTRICT

APPROVED FOR CONSTRUCTION:

BY: PAUL SCIUTO, P.E. NO. CE 51628 DATE

SHEET INDEX

G1	COVER
G2	NOTES, ABBREVIATIONS & SYMBOLS
C1	OVERALL PROJECT PLAN
C2	SHEET KEY GRADING & DRAINAGE
C3	SHEET KEY FRESHWATER & IRRIGATION PIPELINES
C4	SHEET KEY DVR LOOP PIPELINE
C5	PUMP STATION SITE GRADING & DRAINAGE PLAN
C6	FIELD D GRADING & DRAINAGE PLAN
C7	PUMP STATION SITE PIPING PLAN
C8	CONTROL BUILDING PLAN
C9	PUMP SUMP PLAN & SECTIONS
C10	JUNCTION BOX PLAN & SECTIONS
C11	FILTRATION SYSTEM PLAN & SECTION
C12	SOIL MOISTURE SENSORS PLAN & PROFILE
C13	WEATHER STATION PLAN
C14	PIVOT D IRRIGATION PIPELINE PLAN & PROFILE 1
C15	PIVOT D IRRIGATION PIPELINE PLAN & PROFILE 2
C16	MILLICH DITCH DIVERSION PLAN & SECTIONS
C17	MILLICH DITCH PIPELINE PLAN & PROFILE 1
C18	MILLICH DITCH PIPELINE PLAN & PROFILE 2
C19	MILLICH DITCH PIPELINE PLAN & PROFILE 3
C20	TILE DRAIN PIPELINE PLAN & PROFILE 1
C21	TILE DRAIN PIPELINE PLAN & PROFILE 2
C22	SPRING DRAIN PIPELINE PLAN & PROFILE
C23	OVERFLOW DRAIN PIPELINE PLAN & PROFILE 1
C24	OVERFLOW DRAIN PIPELINE PLAN & PROFILE 2
D1–D6	DETAILS
A1	BUILDING ELEVATIONS & SECTION
P1–P37	DVR LOOP PIPELINE PLAN & PROFILE
T1	TRAFFIC CONTROL
S1–S_	STRUCTURAL (NOT PROVIDED AT THIS TIME)
E1–E12	ELECTRICAL

NO.	DATE	BY	DESCRIPTION

SCALE: AS NOTED

DOMENICHELLI & ASSOCIATES

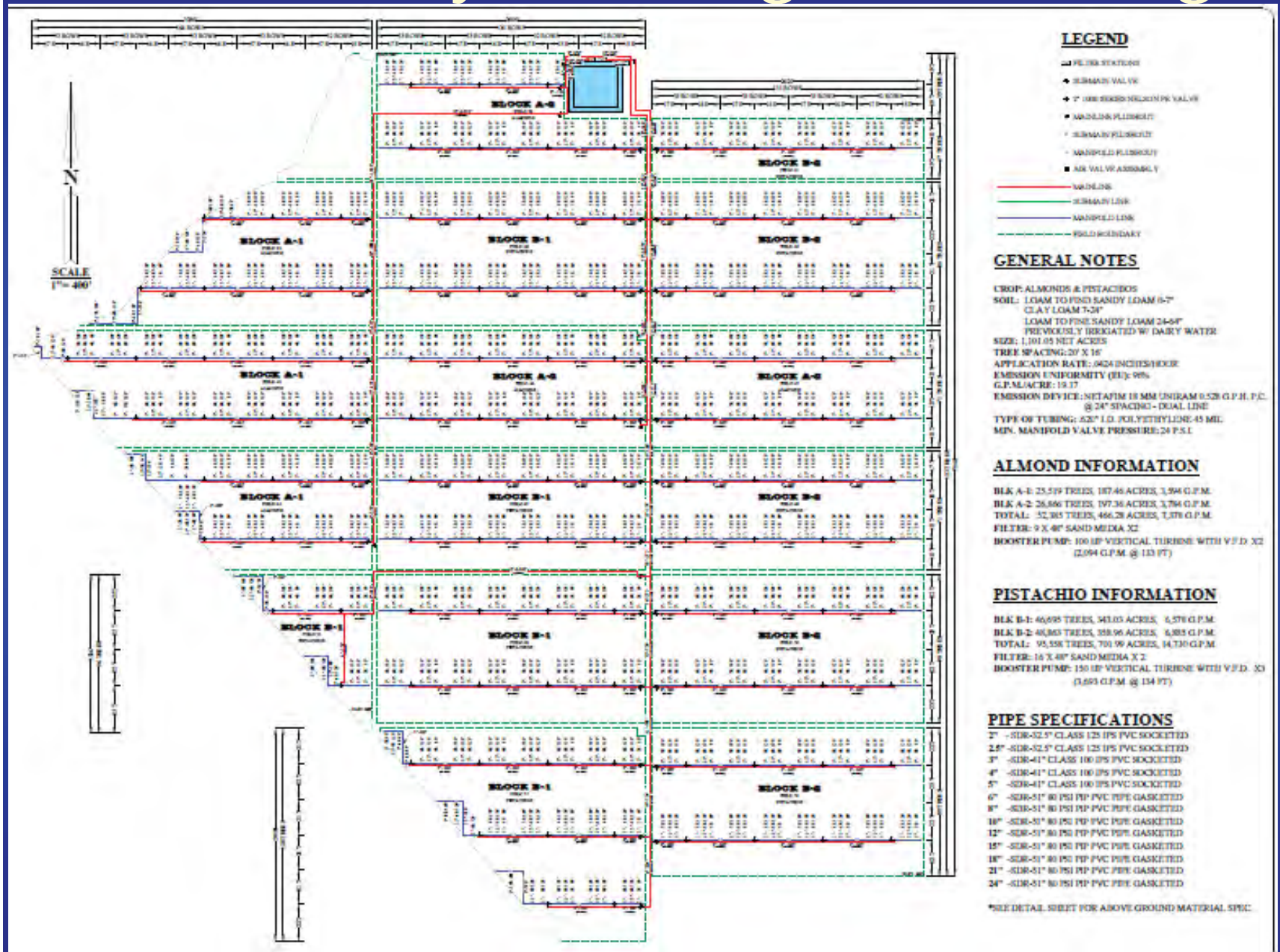
DIAMOND VALLEY RANCH IRRIGATION IMPROVEMENTS

COVER

SHEET G1

Another common problem: People inject chlorine AND SO2

Third Party Checking of New Designs



LEGEND

- PUMP STATIONS
- SUBMAIN VALVE
- 3" GRIF SERIES NELSON PRV VALVE
- MAINLINE FLUSHOUT
- SUBMAIN FLUSHOUT
- MANIFOLD FLUSHOUT
- AIR VALVE ASSEMBLY
- MAINLINE
- SUBMAIN LINE
- MANIFOLD LINE
- FIELD BOUNDARY

GENERAL NOTES

CROP: ALMONDS & PISTACHIOS
SOIL: LOAM TO FINE SANDY LOAM 0-7"
CLAY LOAM 7-24"
LOAM TO FINE SANDY LOAM 24-64"
PREVIOUSLY IRRIGATED W/ DAIRY WATER
SIZE: 1,101.05 NET ACRES
TREE SPACING: 20' X 16'
APPLICATION RATE: .0424 INCHES/HOUR
EMISSION UNIFORMITY (EU): 90%
G.P.M./ACRE: 19.17
EMISSION DEVICE: NETAFIM 18 MM UNIRAM 0.528 G.P.H. P.C. @ 24" SPACING - DUAL LINE
TYPE OF TUBING: .620" I.D. POLYETHYLENE 45 MIL
MIN. MANIFOLD VALVE PRESSURE: 24 P.S.I.

ALMOND INFORMATION

BLK A-1: 25,519 TREES, 187.46 ACRES, 3,594 G.P.M.
BLK A-2: 26,866 TREES, 197.36 ACRES, 3,784 G.P.M.
TOTAL: 52,385 TREES, 466.28 ACRES, 7,378 G.P.M.
FILTER: 9 X 48" SAND MEDIA X2
BOOSTER PUMP: 100 HP VERTICAL TURBINE WITH V.F.D. X2 (2,094 G.P.M. @ 133 FT)

PISTACHIO INFORMATION

BLK B-1: 46,695 TREES, 343.03 ACRES, 6,578 G.P.M.
BLK B-2: 48,863 TREES, 358.96 ACRES, 6,885 G.P.M.
TOTAL: 95,558 TREES, 701.99 ACRES, 14,730 G.P.M.
FILTER: 16 X 48" SAND MEDIA X 2
BOOSTER PUMP: 150 HP VERTICAL TURBINE WITH V.F.D. X3 (5,693 G.P.M. @ 134 FT)

PIPE SPECIFICATIONS

2" -SDR-32.5" CLASS 125 IPS PVC SOCKETED
2.5" -SDR-32.5" CLASS 125 IPS PVC SOCKETED
3" -SDR-41" CLASS 100 IPS PVC SOCKETED
4" -SDR-41" CLASS 100 IPS PVC SOCKETED
5" -SDR-41" CLASS 100 IPS PVC SOCKETED
6" -SDR-51" 80 PSI PIP PVC PIPE GASKETED
8" -SDR-51" 80 PSI PIP PVC PIPE GASKETED
10" -SDR-51" 80 PSI PIP PVC PIPE GASKETED
12" -SDR-51" 80 PSI PIP PVC PIPE GASKETED
15" -SDR-51" 80 PSI PIP PVC PIPE GASKETED
18" -SDR-51" 80 PSI PIP PVC PIPE GASKETED
21" -SDR-51" 80 PSI PIP PVC PIPE GASKETED
24" -SDR-51" 80 PSI PIP PVC PIPE GASKETED

*SEE DETAIL SHEET FOR ABOVE GROUND MATERIAL SPEC.

ITRC

The New California Energy Commission WET program

1. Distribution Uniformity >= 0.92 or more (brand new), calculated using the Cal Poly ITRC design computational procedure that is based upon field (not hose) uniformity. The values used to compute this field (global) uniformity must be provided, and must include:
    a. Flow rate differences of individual emitters due to pressure differences. Even with PC emitters, there is some impact of pressure differences. This must be clearly shown using excellent pressure/discharge graphs, indicating the range in pressures and flows expected across the complete field.
    b. Non-uniformity due to manufacturing variability. The computation must show:
        i. The number of emitters assumed per plant
        ii. The manufacturer c.v.
    c. Unequal drainage.
2. Proof of adequate filtration and chemical injection for maintenance must be provided. Filtration sizing must conform to industry standards of velocity as related to degree of filtration required.
3. Proof of adequate and simple means of flushing tapes/hoses, with necessary hardware, must be provided. Flushing manifolds must be designed to guarantee a minimum tape/hose end flushing velocity of 1.5 ft/sec.
4. Maximum pressure at outlet of pump (upstream of the filter) = 30 psi, plus any uphill elevation.
5. The pump must designed to deliver the low pressure with the required maximum system flow rate, having an impeller/bowl efficiency of better than 80% at that point.

Specs for Variable Frequency Drives (VFDs)

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VFD Requirements for On-Farm Irrigation Pumps

C. Burt – Cal Poly ITRC 8/19/2015

1. Cabinets must be NEMA-3 or better, and mounted on a concrete pad.
2. The complete cabinet (not just the top) must be shaded from the sun, with ample air circulation provided between the cabinet and the shade.
3. Motors must be premium, inverter duty that meet or exceed **NEMA MG-1 Part 31 Standard**.
4. For vertical hollow shaft motors up to 100 HP a shaft grounding ring (e.g., www.est-aegis.com) must be installed on the bottom guide bearing of the motor. For motors greater than 100 HP, an insulated bearing carrier on the upper bearing (Bartlet Bearing is a source of such units) must **also** be installed.
5. No exterior air can be drawn into the NEMA-3 cabinet. All cooling must be external, although an internal fan will be needed to circulate internal air over cooling coils.
6. Minimum technical specifications include:
   - Microprocessor-based inverter logic isolated from power circuits
   - Buffered Pulse Width Modulated (BPWM) output waveform using 4th generation Insulated Gate Bipolar Transistors (IGBT) technology
   - A guaranteed ability to provide continuous output amperage of 15% greater than the maximum amperage required by the project for the motor at a specified input voltage
   - Resolution of output control frequency (0-70 Hz) of +/- 0.003 Hz
   - DC link choke for the DC bus reactor
   - A 5% DC line reactor and passive EMI/RFI filters on each input leg.
   - Non-fusable surge arrestors on incoming power lines, in addition to the DC line reactor. The surge protectors must be outside the panel, if there is a possibility that they will explode when activated.
   - Voltage rating of 380-480V +/- 10%.
   - Ability to support a motor cable length of 100 feet (minimum) or any greater length specified for this application without voltage reflection or other problems
   - Temperature rating for 100% performance at 50 deg. Celsius ambient. The means for cooling the cabinet must be explicitly defined.
   - 6 pulses
   - Testing by the manufacturer of the completely assembled package listed above
   - Drive efficiency (including all associated filters) of 96.5% or better at full speed and full load
   - Displacement power factor between 1.0 - .95 lagging at all speeds and loads
   - The ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.
   - 3-position Hand-Off-Auto (HOA) switch and speed potentiometer. When in "Hand", the VFD will be manually started, and the speed will be controlled from the speed potentiometer. When in "OFF", the VFD will be stopped. When in "Auto", the VFD will start via a signal from an internal PLC, and its speed will be controlled via PLC communications. For units with bypass capability, a 3-position Drive-Off-Bypass switch is required.
   - The VFD shall have input line fuses standard in the drive enclosure
   - The VFD shall be optimized for a 2kHz carrier (switching) frequency. The carrier frequency shall be adjustable to a maximum of 8kHz. The carrier frequency shall be adjusted to the maximum frequency that eliminates audible "hums" in the motor and drive.
   - All EMI and RFI must be contained and controlled to meet IEC 61800-3

Hopefully this provides an idea of what ITRC does

We are looking forward to working with Metropolitan Water District