

The POWER of DATA – Sensor data-induced cultural change within the Grassland Basin

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Early years— when not in a ditch



Early years— when not in a ditch



Some things never change – 2009

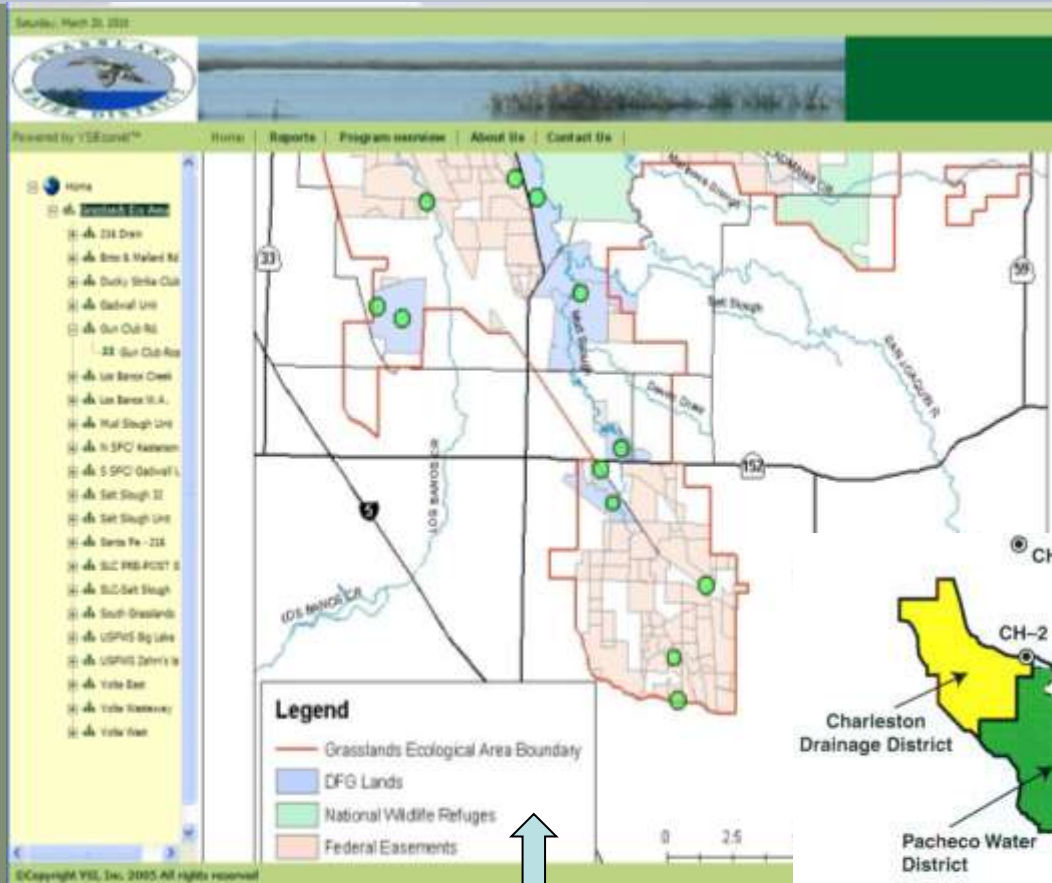


Basic premise :

- **Easy to get enthralled by our technology – models, decision support systems etc.**
- **Can elicit a type of type of intellectual laziness – “thinking within the box”**
- **We forget the power of mental models (i.e. the instincts, perceptions built from experience and making mistakes)**
- **Can cause us to miss soft technology solutions to problems**
- **Hard to spend as much time as we should in the field with our client stakeholders**

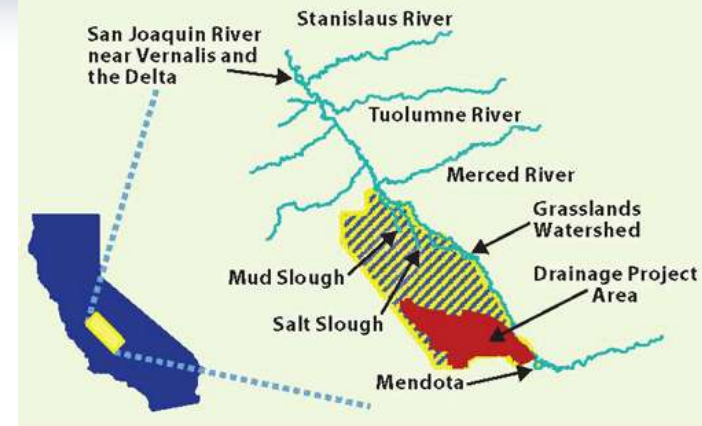
In support of my hypothesis – four anecdotes:

- **Tim and the MACE flow sensor readout button**
- **Dave and flow QA in the Volta Cross Channel**
- **Grassland Water District – sensor network data visualization**
- **Water table elevation sensors in Panoche WD – soft police power**

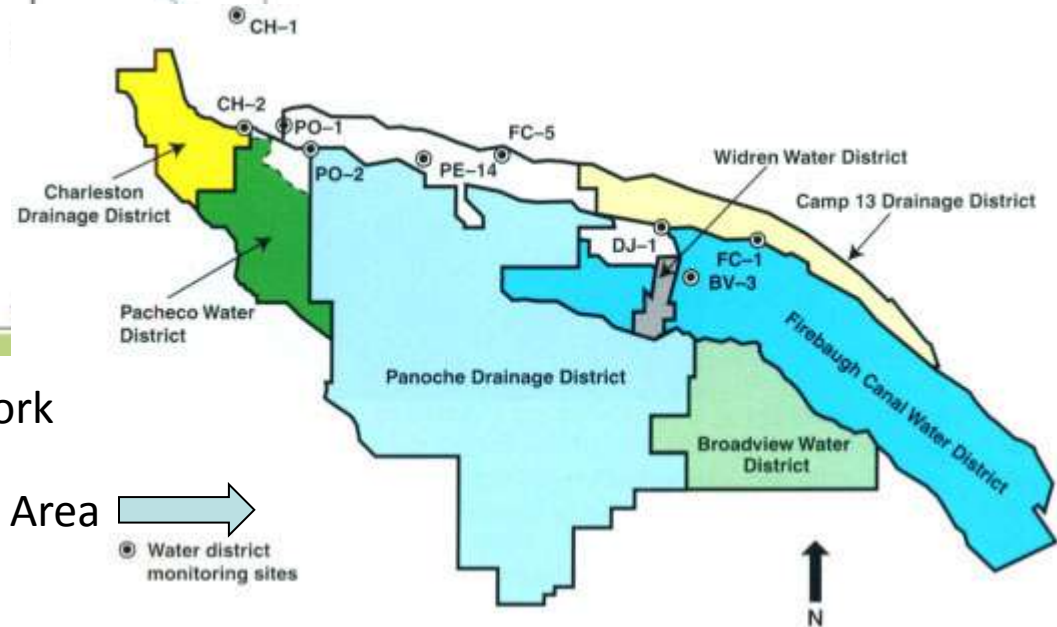


Grassland Ecological Area sensor network

Grasslands Bypass Project Area



Grasslands Drainage Basin



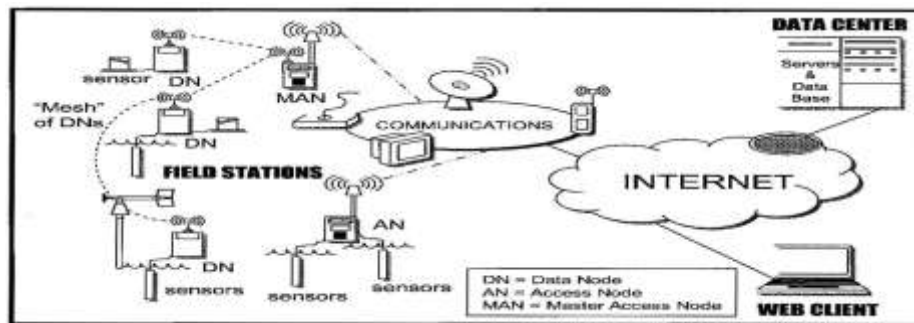
Water district monitoring sites

1. Tim and the MACE flow sensor readout button

- Tim – wetland water master with more than 30 years of experience. Technology skeptic. Weir stick + Myron EC tester + labrador in pickup
- Missteps during real-time sensor deployment
 - V-notch weirs
 - Metal sheds - Campbell logging systems
 - MACE sensor data processing – decimal point error



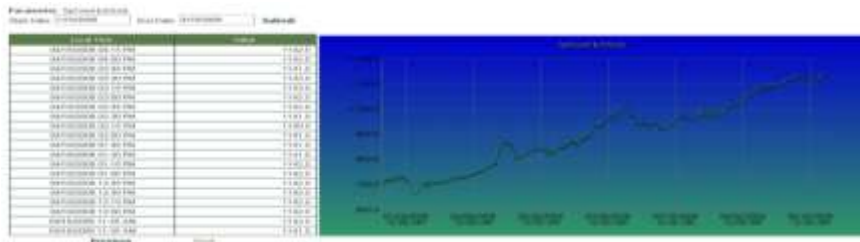
- **What we did right!**
 - YSI-Econet – web based data access + Google maps
 - YSI data interface – designed by CDFG biologist
 - Cycled CDFG employees to perform sensor network maintenance and QA – gained exposure to system
 - Public relations – provided tours of sensor network





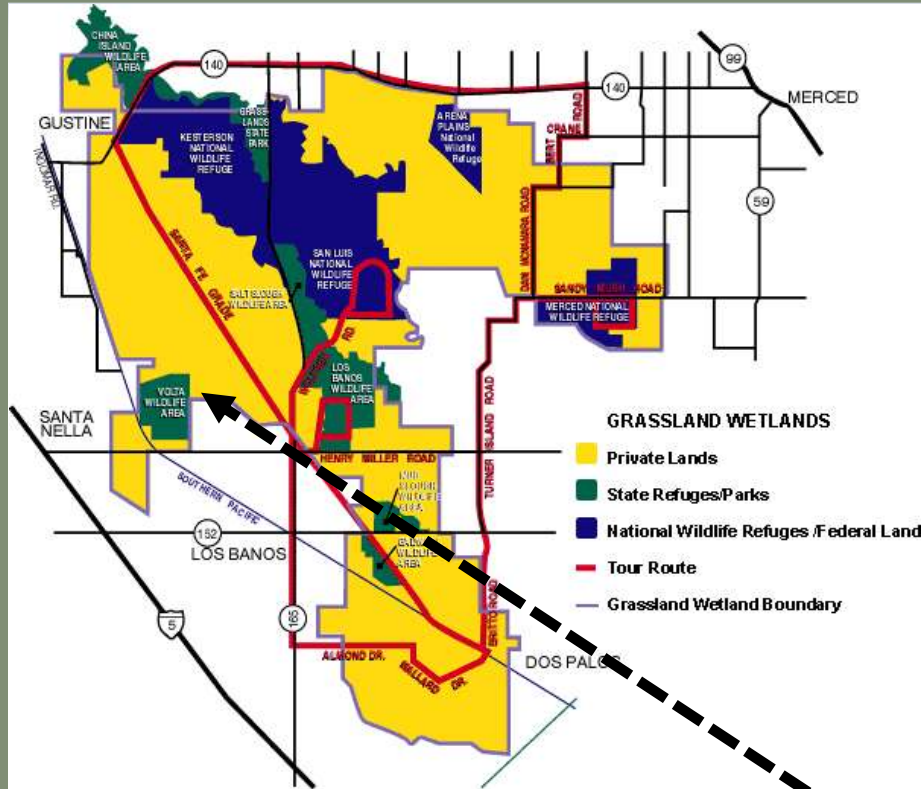
- **Tim's new mental model**

- Push-button access to flow data
- Interrogates system while still at home – prepare for troubleshooting and repair before go to field
- Minimizes pond disturbance when taking flow and EC measurements
- Has had profound impact on acceptance of sensor data among landowners
- Happy wife



Dave and data QA in the Volta Cross Channel

- **District Manager and Governmental Affairs specialist
– focus on water supply**
- **Tolerated water quality projects – grants helped pay bills**
- **Saw little connection between sensor network and water acquisition and conservation activities until**



Monitoring station located in north-west corner of Volta Refuge

Cross channel monitoring station

- GWD delivery from SLDMWA
- Sontek acoustic Doppler sensor



Flow rating after installation showed discrepancy

- District slow rating showed 30% less flow than rating used by Water Authority – District being overbilled!
- District manager instantly acquired “new” water supply
- Complete change in attitude toward utility of real-time monitoring
- District manager became a vocal advocate – promoted biologist to lead District environmental program
- District found utility in real-time monitoring network for water conservation operations and planning

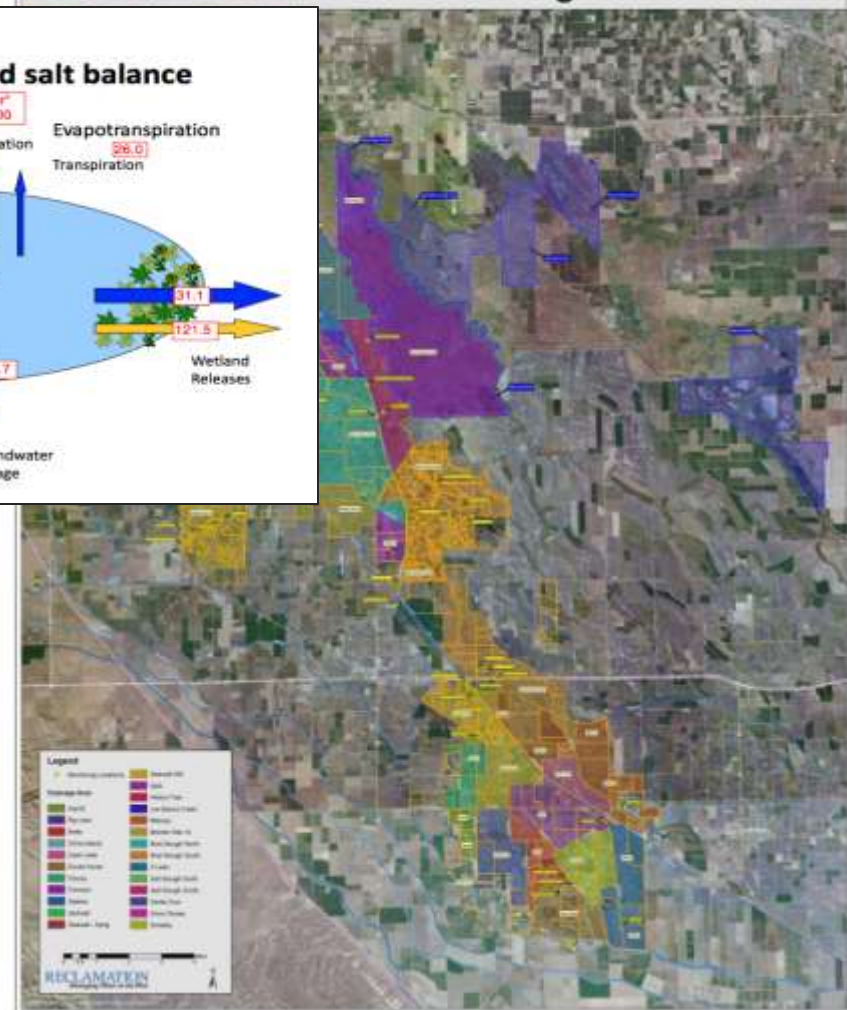
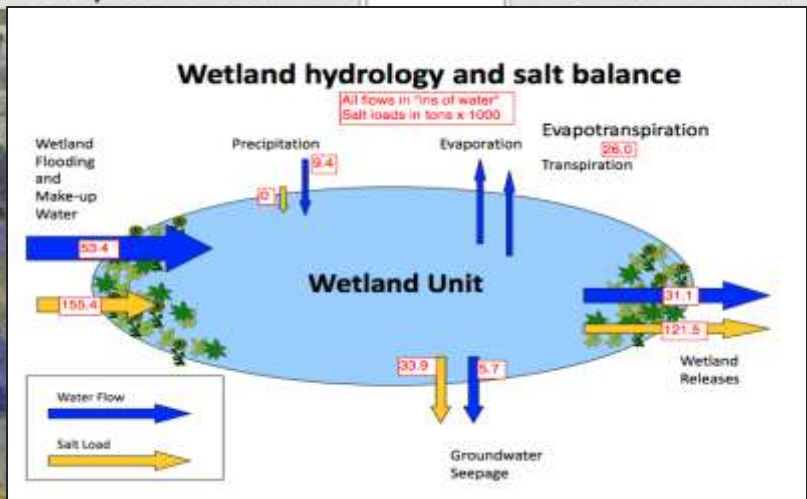
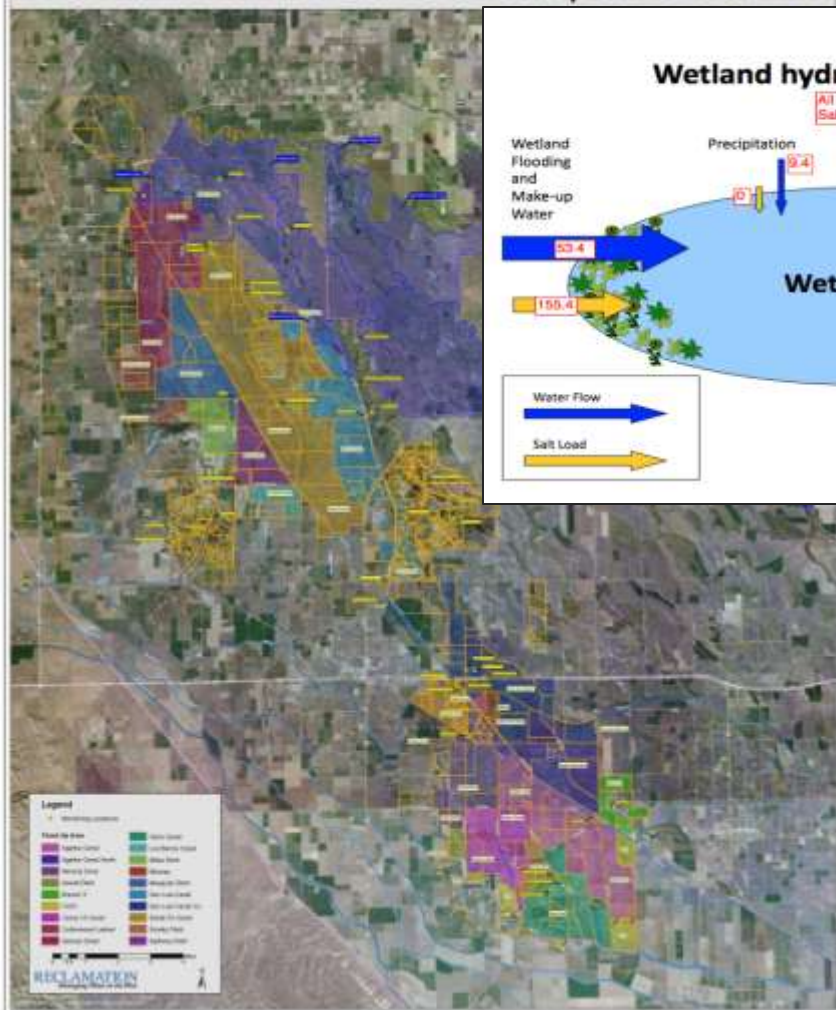
Grassland WD – real-time salinity management

Initial modeling approach

- Develop flood-up and drainage maps within GIS
- Develop daily water and salinity balances based on monthly WETMANSIM – wetland salinity management simulation model
- Use real-time inflow data, pond depth objective data (outflow) and weather station records to track salinity
- Calibrate against District outflow data from 5 real-time monitoring stations
- Use current pond salinity/salt load/remaining volume as basis for District drainage drawdown decisions

Wetland Flood-Up

Wetland Drainage



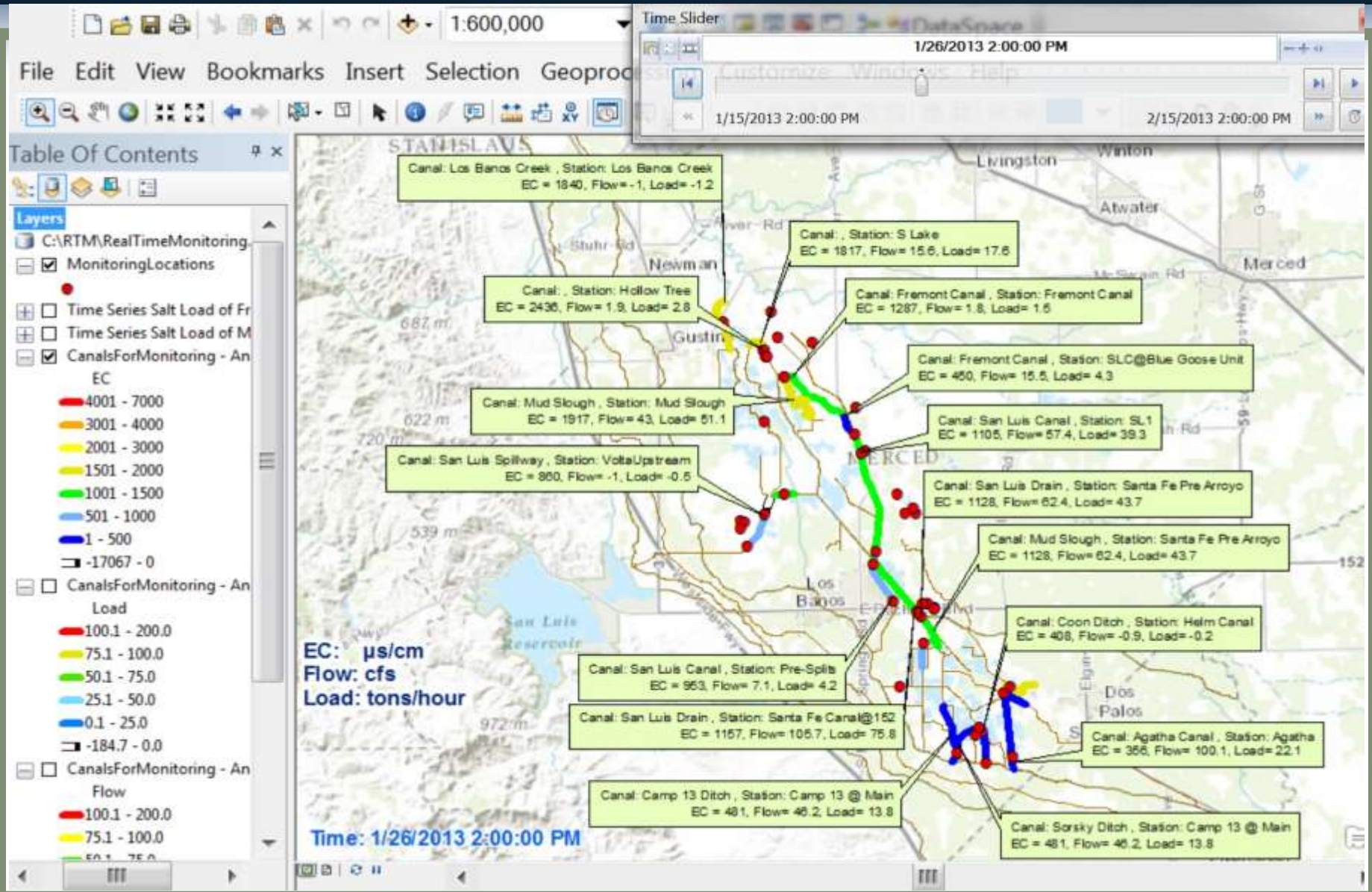
Grassland Water District – reservations

- **Model attempting to predict conditions beyond the capability of the District to understand or measure**
- **Insufficient data to fully support proposed modeling**
- **District reluctant to appear too prominent in vanguard of real-time salinity management**
- **Suggested a less ambitious approach that would allow better salt load characterization and promote system understanding**
- **Address limitations of existing web-based sensor network**

Grassland Water District – sensor data visualization

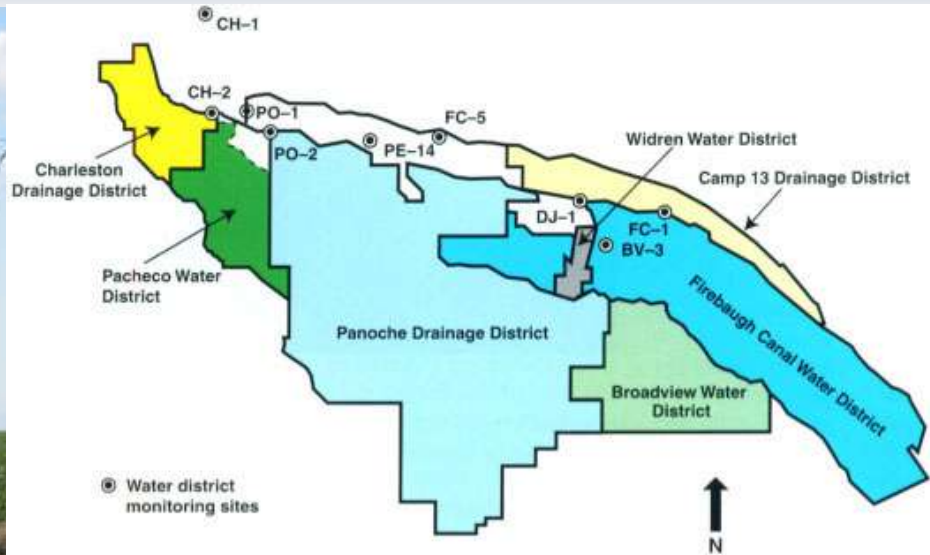
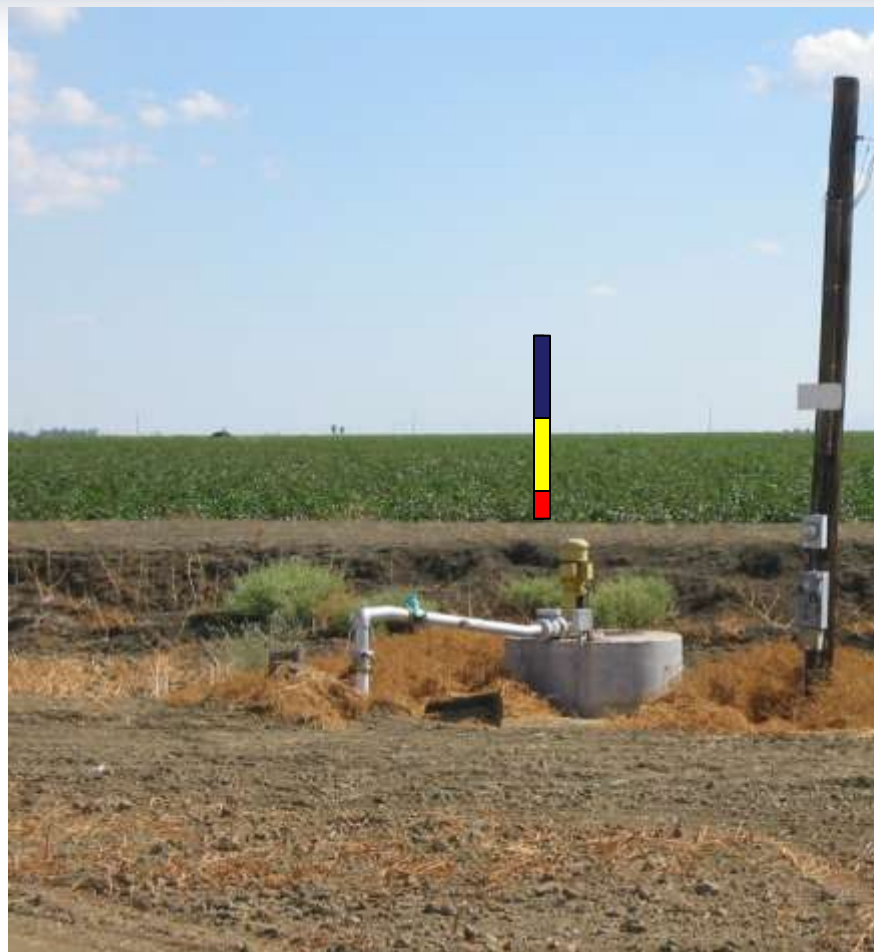
Limitations of YSI-EcoNET sensor network reporting system

- Provides data and time series plots of flow or EC for one site at a time - can't visualize output for channels within entire district
- Can't calculate salt load – reports only measured parameter values – no QA capability
- Provides limited support for real-time salt export decision making – can't combine data to view daily, weekly or monthly salt exports to Mud Slough and SJR
- Inability to share portions of data with public or State and Federal refuges – all of site is either public or private (username and password protected)



Soft police power - water table elevation sensors in Panoche WD

- **Grassland Bypass Project sets monthly and annual limits on selenium loading to Mud Slough (and SJR)**
- **Complexity and heterogeneity of system beyond model decision support capabilities**
- **Selenium loading not well correlated with salinity. Selenium monitoring expensive – analyzed in Lab.**
- **Policy decision – ensure equitable selenium load allocation among six participating water districts**



Drainage sump pumps in Panoche Water District
Simulated water table depth monitor

Data-driven selenium load management system

- Panoche Water District assumed responsibility for GBP subarea
- Installed totalizing meters and EC monitors at every drainage sump discharge – data downloaded weekly
- Developed flow - selenium load relationship for each sump
- District-level drainage reuse system developed
- Installed color-banded water table elevation monitors visible from the road in each tile drained field

Program results

- **Grassland Bypass Project – highly effective. Project has met all monthly and annual selenium load objectives for past 13 years**
- **Water table color-banded monitors effective in improving selenium load management**
- **Simple accounting system used to forecast end-of month totals and determine percent of selenium load reused**
- **Internal police power has allowed adaptive approach that improved selenium load management capability over time**

Summary

- **Models don't always provide the best decision support solution**
- **However our clients may need help developing the “mental” model of their own decision space to arrive at a solution**
- **Four instances have been described where data, signature events and modeling alternatives have provided cost effective environmental decision support and changed attitudes**
- **We need to be adaptive, listen to our clients and be willing to think “outside the box”**

