Fluid Fertilizers and Water Quality and Quantity Issues in Western Irrigated Agriculture

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Water Issues Facing CA Agriculture

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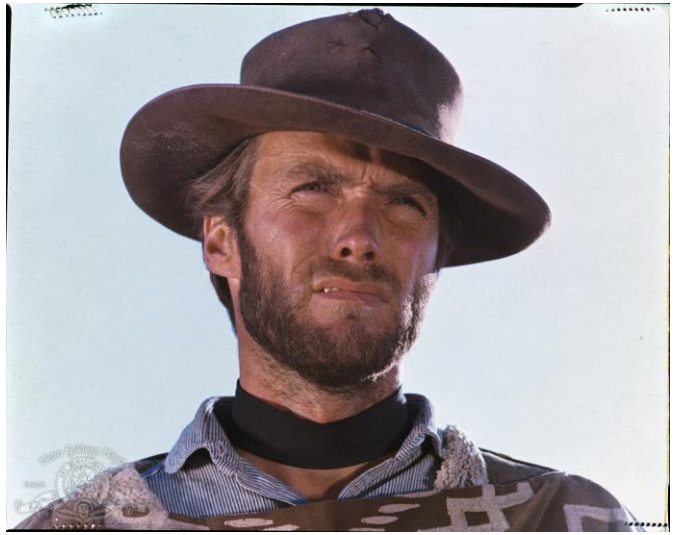


The Good The Bad And The Ugly

Water Issues Facing California Agriculture

- **The Good**
  - CA ag is very vib
  - CA produces > 1
    and nuts
  - CA farms and ra
  - CA is #1 in cash
    value

-) different commodities
- d 2/3 of country's fruits
- ı cash receipts
- % of national total ag

Water Issues Facing California Agriculture
The Bad

Two Main Issues with Water

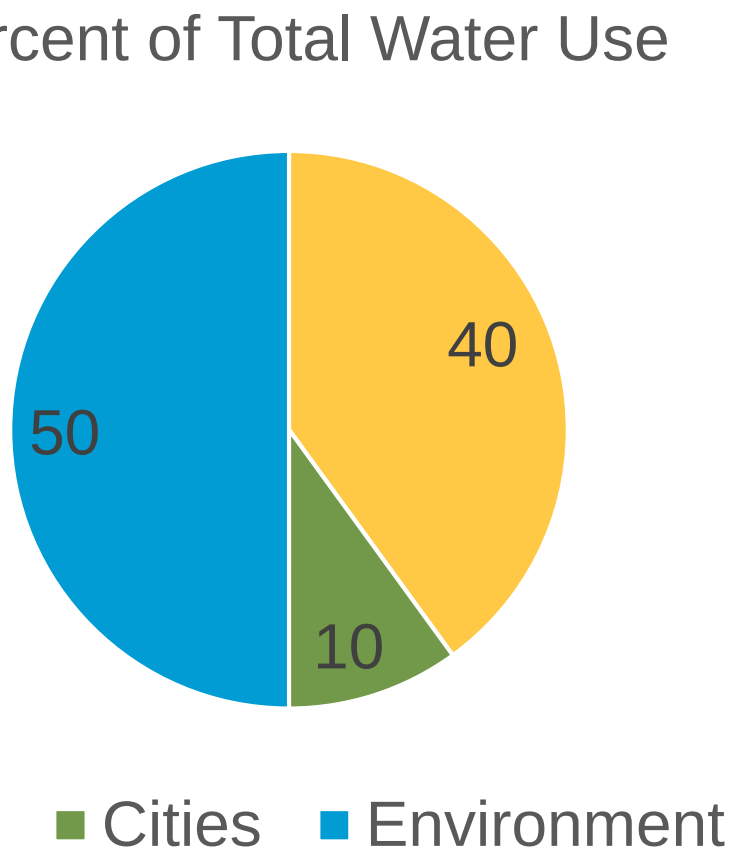
Quality

Quantity

Water Quality

- California Ag is virtually 100% irrigated
- Ca 9,000,000 acres of irrigated agriculture
- Very arid and very hot climate = high crop demand for water
- 60-100 million acre feet of water used in CA

California Water Use



Source: California Department of Water Resources

Water Quality - Salinity

"Salinity in water is irrevocably associated with irrigated agriculture."

James E. Ayers, USDA ARS, Parlier CA, 2003

Water Quality - Salinity

How do salts carried in irrigation water harm plants and reduce productivity?

- **Accumulation of toxic metals**
  - Sodium
  - Chloride
  - Boron

Chloride Toxicity in Almonds

Water Quality - Salinity

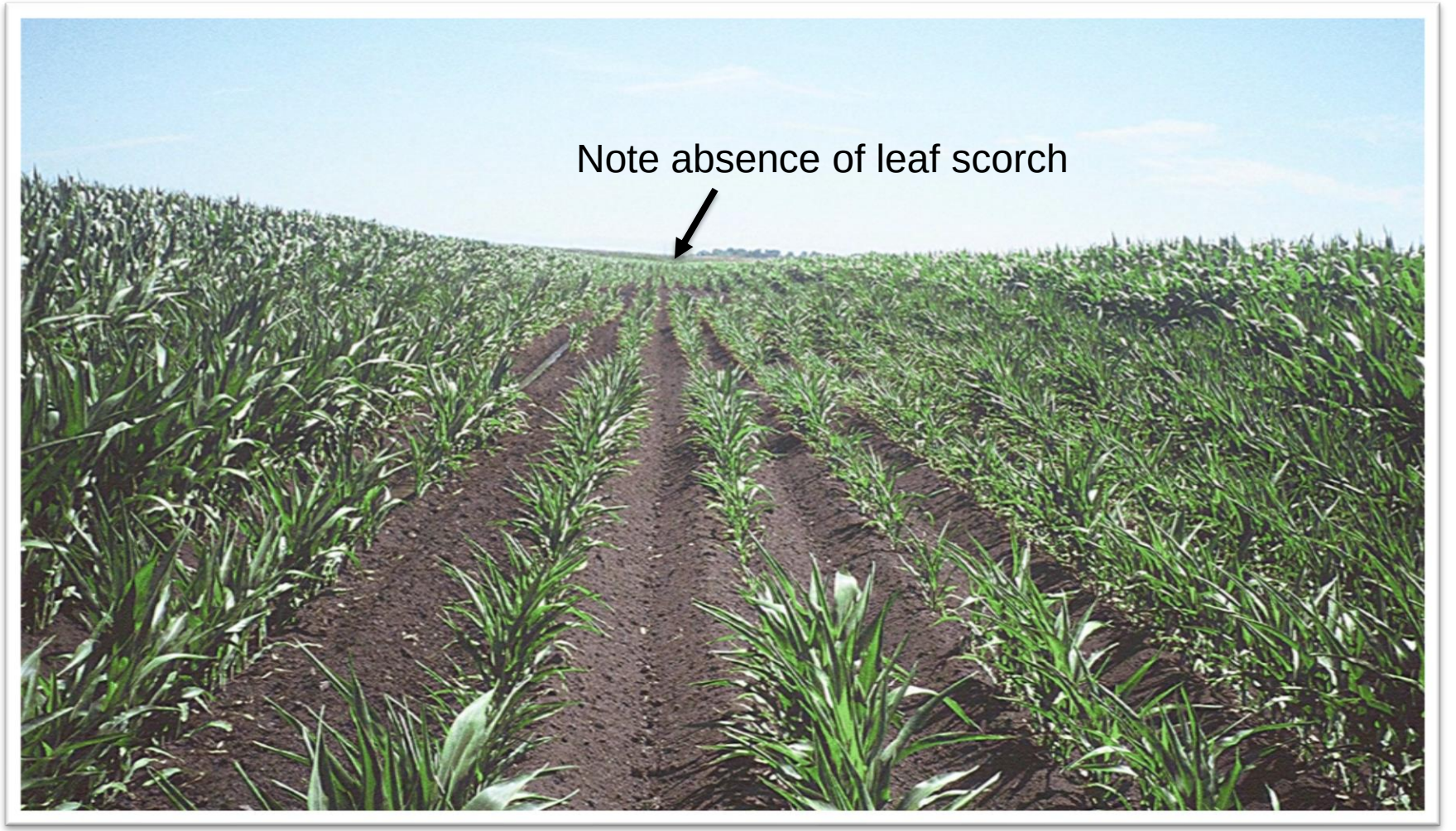
How do salts carried in irrigation water harm plants and reduce productivity?

- **Accumulation of toxic metals**
  - Sodium
  - Chloride
  - Boron
- **Increased osmotic stress**

Symptoms of Osmotic Stress

Sorghum grown under saline irrigation

Symptoms of Osmotic Stress



How Do Soil Salts Accumulate?

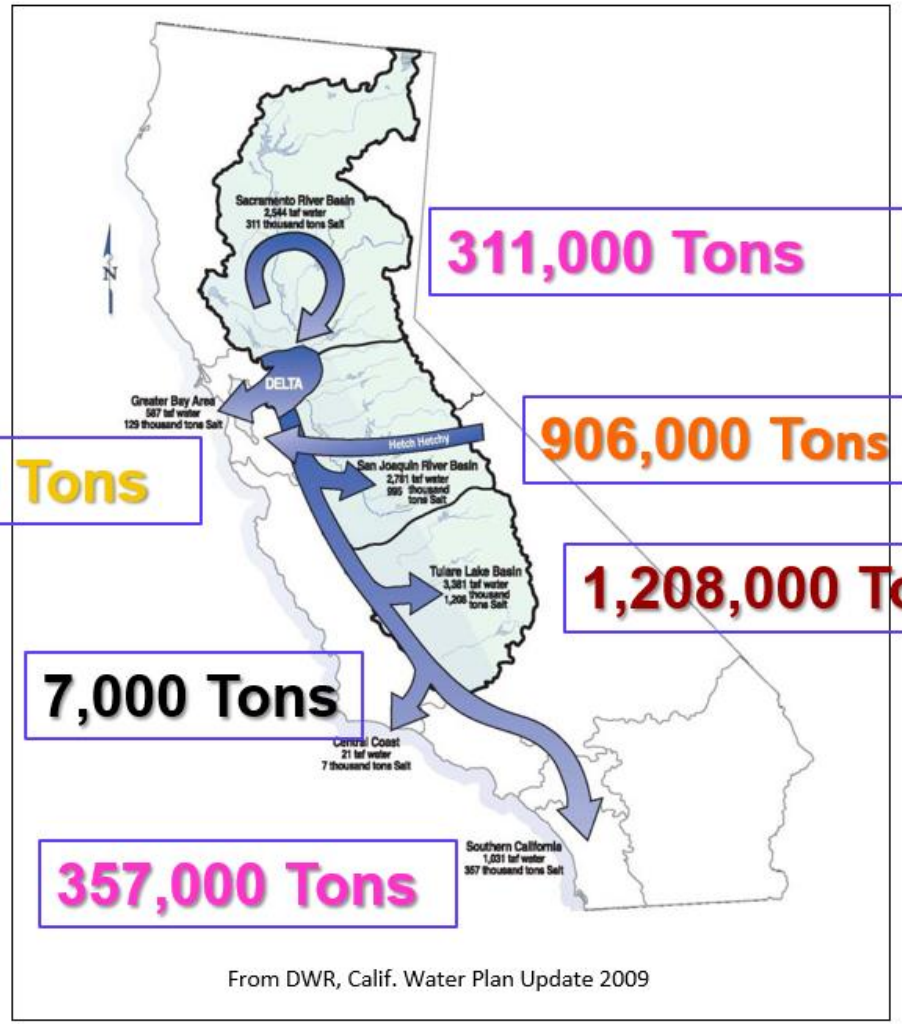
Salinization – A Global Threat

- **10-20% of the ~250 million ha (620 million acres) of irrigated land in the world is currently degraded due to secondary salinization (Schoups et al. 2005; Munns and Tester 2008; Marschner 2012).**
- **~4 million acres of irrigated cropland in California, corresponding to more than half of the total, are affected by salt stress to varying degrees (Letey 2000; Schoups et al. 2005).**
- **Estimated* >30% of orchard acreage in Central Valley is now using irrigation water that exceeds recommended salinity levels**.**
- **Drought (and politicians) worsens the situation by:**
  - Reducing leaching,
  - **Decreasing the availability of higher quality surface water for irrigation, and increased dependence on lower-quality groundwater.**

THIS IS A BIG DEAL!

Salt – Trans Basin Transport Per Year

SURFACE WATER salt transfer



311,000 Tons

906,000 Tons

129,000 Tons

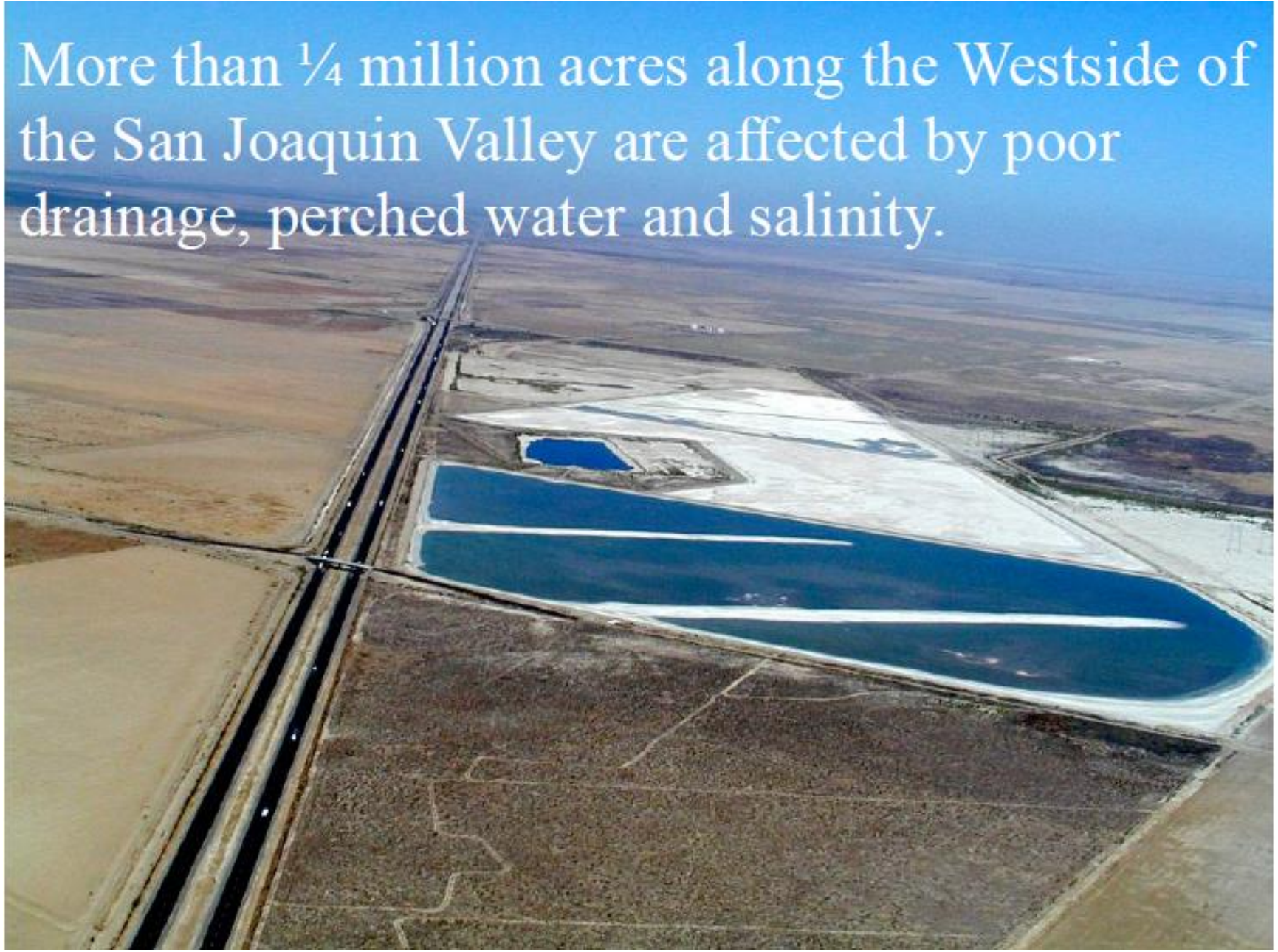
1,208,000 Tons

7,000 Tons

357,000 Tons

3

Central Valley Water Board Meeting: 6 December 2013


More than ¼ million acres along the Westside of the San Joaquin Valley are affected by poor drainage, perched water and salinity.


Perched water @ 3.5
foot below berm.

Pistachios – A Very Salt Tolerant Tree Crop

WATER QUALITY AND SALINIZATION ARE IMPORTANT ISSUES

Water Issues Facing California Agriculture

The Bad

Water Quantity or Availability

- Drought
- Climate Change (?)
- Shifts in Cropping Systems
- Aquifer Overdraft
- New Regulations
- Political Pressure

Sources of Irrigation Water in California

1. **Surface Source: Reservoirs, lakes, streams and rivers**
    1. About 1500 reservoirs in CA
    2. Total storage capacity of 43 million AF
    3. Allocations can range from 0-100% depending on year and area

Sources of Irrigation Water in California

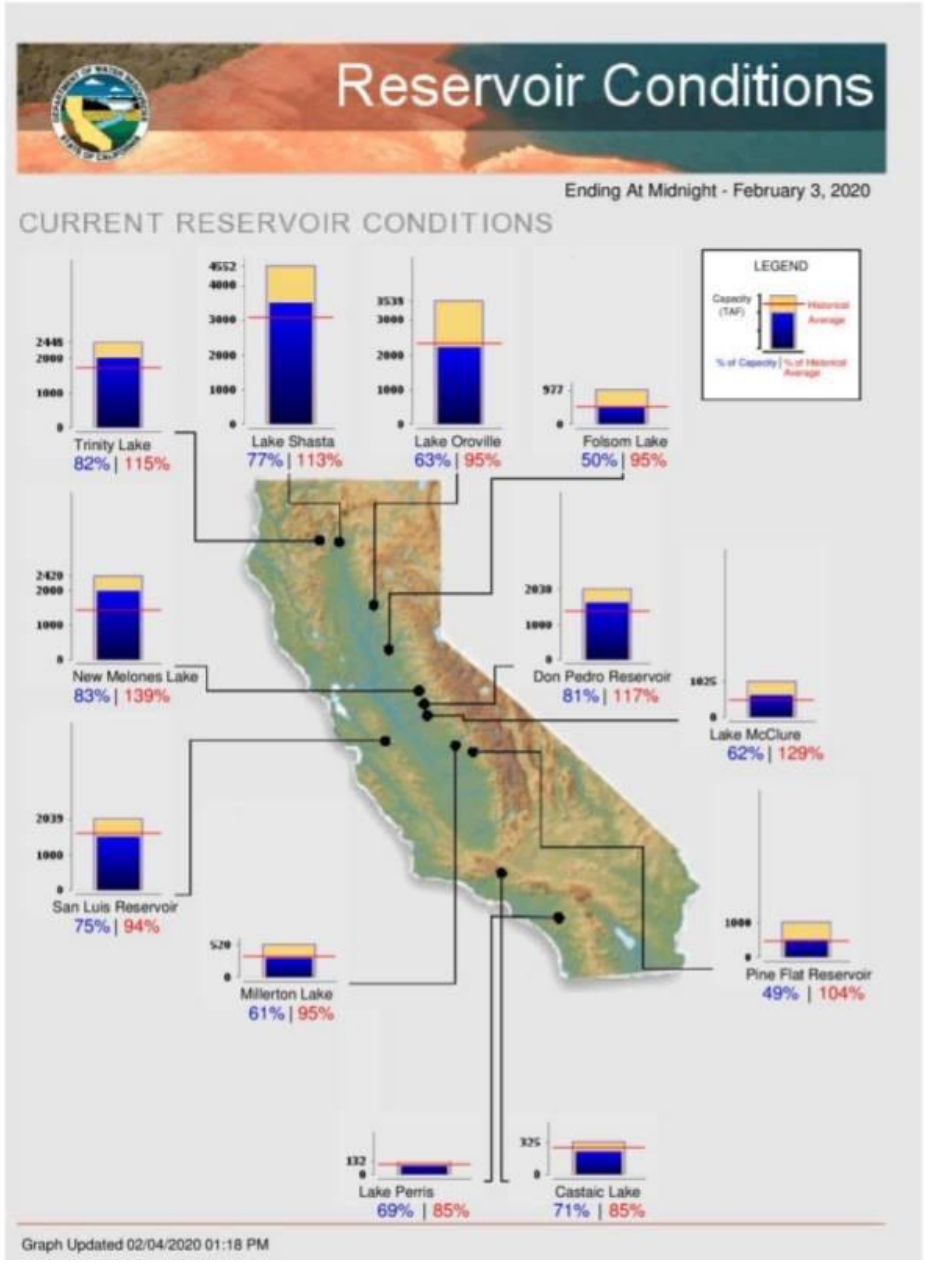
1. **Surface Source: Reservoirs, lakes, streams and rivers**
    1. CA has $187 B in unmet infrastructure needs including dam maintenance
    2. Oct. 2019 DWR data indicates 102 dams had rating of fair, poor or unsatisfactory
    3. Of these 84 had hazard classification of significant or above, indicating risk to life or property should the dams fail
    4. Powerful environmental groups who want dams demolished argue it is now cheaper to take down dams then make repairs

Oroville Dam – Feb. 15, 2017

Some Good News

Reservoir Conditions

As of February 3, 2020, Northern California reservoirs are between 95-115% of historical average and 50-82% of capacity. The central ones are between 94-139% of historical average and 49-83% of capacity.



Sources of Irrigation Water in California

1. **Surface Source: Reservoirs, lakes, streams and rivers**
2. **Ground water**
    1. 515 alluvial groundwater basins and sub-basins
    2. 38-46% of states water needs
    3. Over drafting is a serious problem (more on this later)

Sources of Irrigation Water in California

1. **Surface Source: Reservoirs, lakes, streams and rivers**
2. **Ground water**
3. **Sierra Snowpack**
    1. On average supplies about 1/3 of state's supply
    2. Meltdown and runoff during summer critical to resupply lakes and reservoirs filled earlier from winter rains

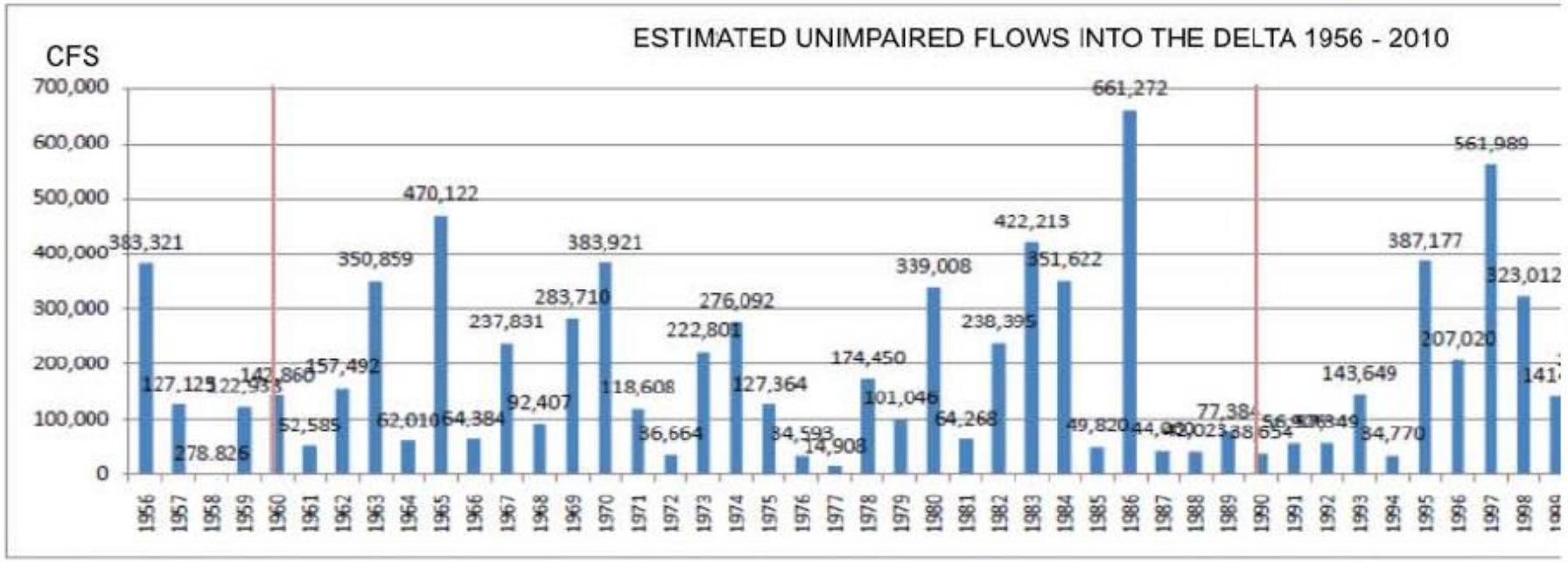
Drought and Climate Change

- **Droughts are a historical reality for CA**
- **In wet years we are blessed**
  - High quality, abundant snowmelt water
  - Good surface water allocation to ag by DWR
  - Leaching winter rainfall
  - Full reservoirs to carry through the dry season
- **In dry years – just the opposite**
- **Climate Change????**

Drought and Climate Change

DELTA TIMELINES 2: Inflow and Outflow reporting ... Or

FRESHWATER INFLOW TO THE DELTA



Peak Delta Inflow (TOT) data is from the following Dayflow website: http://www.water.ca.gov/dayflow/output/Output.cfm accessed on 2/10/2011

Shifts in Cropping systems

- **Movement away from lower income row crops to higher value permanent crops – tree crops and vines**
- **“Cotton is King”in 70’s and 80’s**
- **Acres have been replaced**

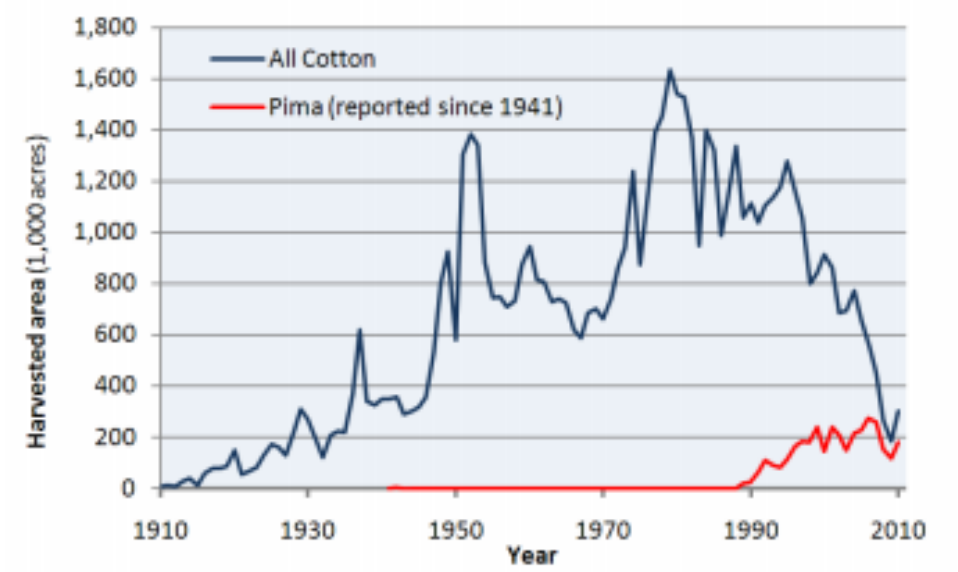


Figure 1: Harvested cotton acreage in California since 1911 [7, 10].

UCDAVIS UNIVERSITY OF CALIFORNIA

Shifts in Cropping systems

- **Movement away from lower income row crops to higher value permanent crops – tree crops and vines**
- **“Cotton is King” 70’s and 80’s**
- **Almond is now king**
  - 1960 113,000 acres
  - 1970 292,000 acres
  - 1980 389,000 acres
  - 1990 432,000 acres
  - 2018 1,390,000 acres

Almond Facts

- **2.2 billion meat pounds produced in 2019**
- **CA provides 80% of world supply**
- **7th largest US food export**

Shift in Cropping Systems

- **During dry years or when water allocations are low row crop acres can be fallowed**
- **Permanent crops cannot be fallowed**
- **So, during dry years what options do growers have?**
  - Deficit irrigation – smaller nut size and yield reductions
  - Sacrifice poorer producing orchards for higher producing orchards
  - Drill new wells/increase reliance on groundwater

The Big Picture

- More acres of permanent crop + drought = more wells, less surface water, higher salt loads, less/no water for leaching
- Increased reliance on groundwater

Consequences of Overuse of Groundwater

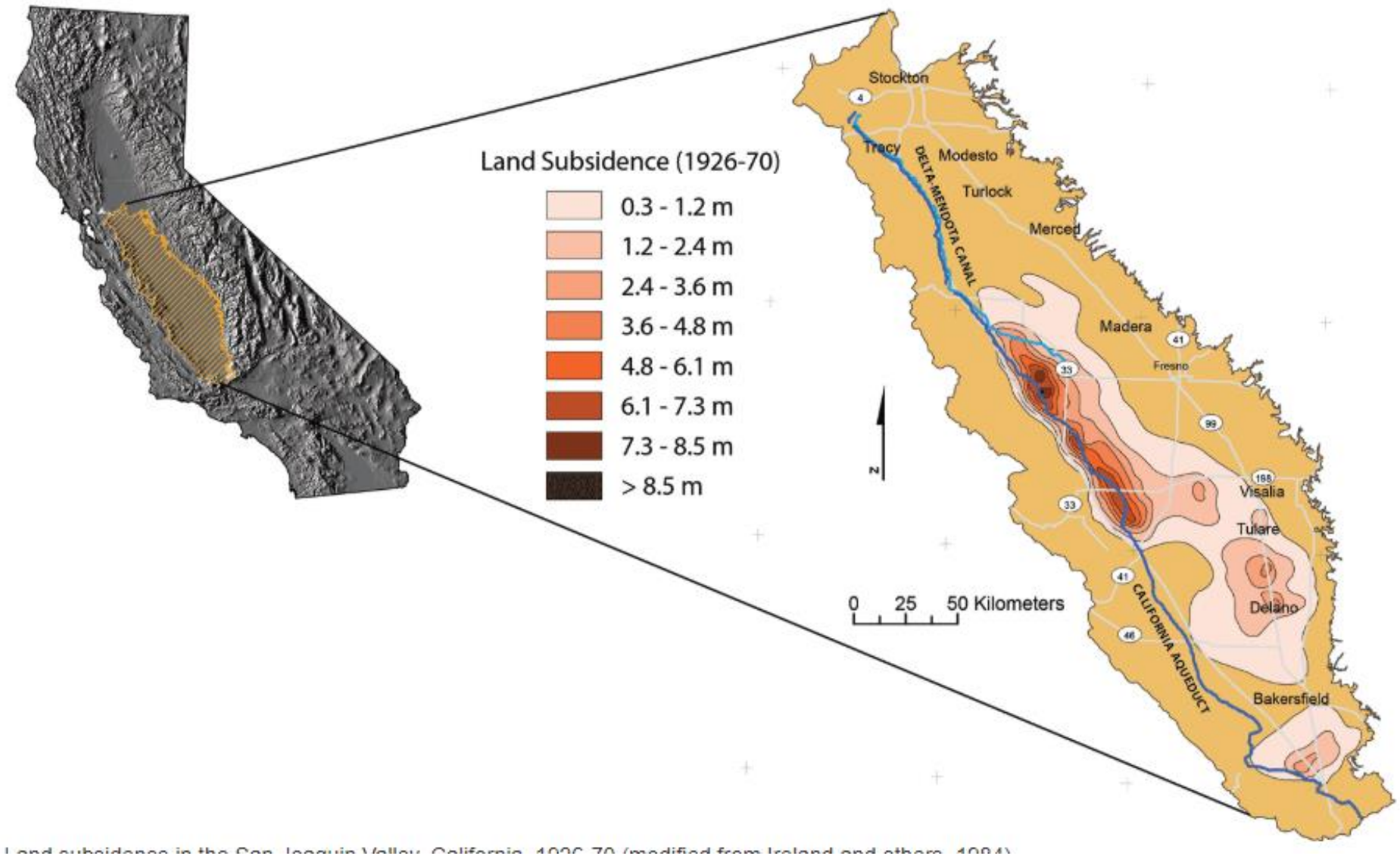
- **On average CA is over-drafting groundwater by 2 million AF per year**
- **Long term consequences**
  - Deeper, more expensive wells
  - Poor water quality and effects on soil health and productivity
  - Dry wells
  - Seawater intrusion
  - Subsidence

Subsidence

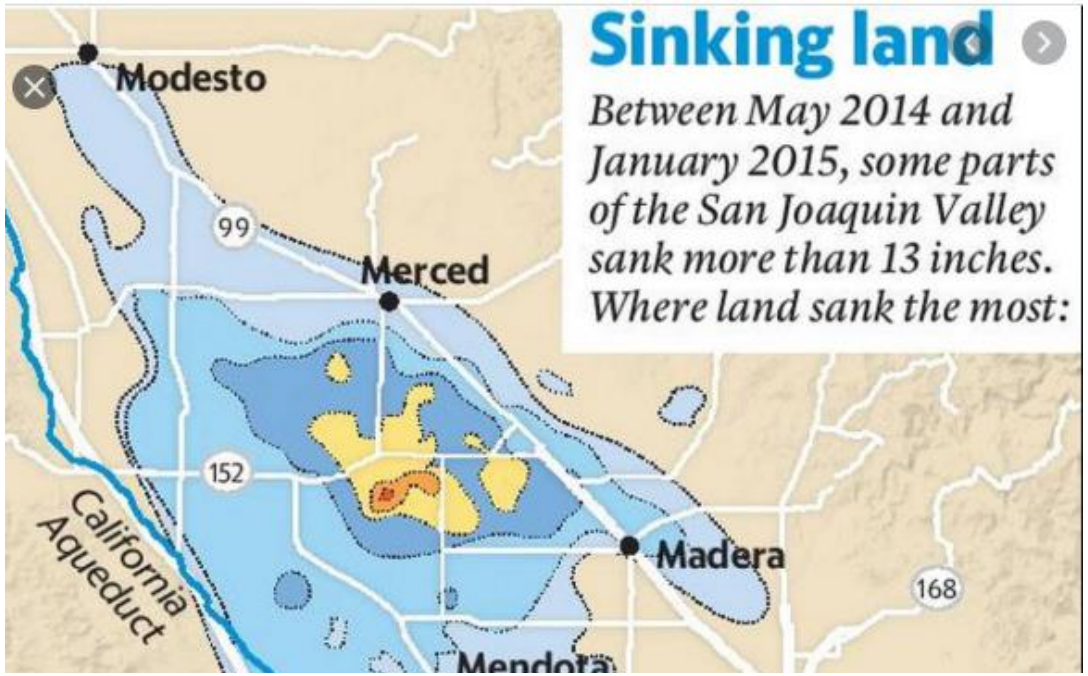
- **When aquafer recharge rates cannot keep pace with pumping rates, land sinks**
  - Reduces groundwater storage capacity
  - Damages aqueducts and flood control structures

Problem: Subsidence

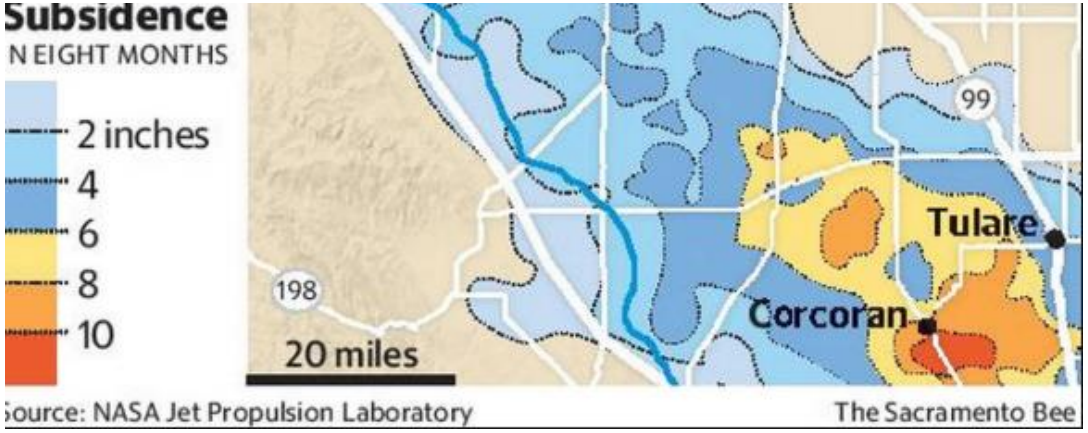
Problem: Subsidence



Land subsidence in the San Joaquin Valley, California, 1926-70 (modified from Ireland and others, 1984)



Clearly, this is NOT sustainable



California Agriculture

This where the ugly comes in

California's Head Shed – Something Has to be Done

Sustainable Groundwater Management Act

- SGMA
- Signed into law Sept. 16, 2014 by Gov. Jerry Brown
- Halt overdraft and bring groundwater basins into balance
- “groundwater management in California is best accomplished locally.”
- Establishes local Groundwater Management Agencies
- Penalties may include up to $500 for each acre-foot in excess of authorized amount and $1100 for each additional day for continuation of violation

Sustainable Groundwater Management Act

- **Sustainability Plans**
  - Due Jan. 31, 2020 for critically over-drafted basins
  - Due Jan. 31, 2022 for high and medium priority basins
- **Public Policy Institute of California**
  - Estimates 500,000 acres of irrigated crop land will be taken out of production (that's 500,000 acres that won't be receiving Fluid Fertilizers)

California Water Regulatory Environment

- State Water Resources Control Board
- Department of Water Resources
- Department of Conservation
- Department of Fish and Wildlife
- Department of Water Resources
- Cal EPA
- Natural Resources Agency
- Regional Water Quality Resources Control Board
- Regional Water Quality Control Boards (9)
- Irrigated Lands Monitoring Program
- Water Commission
- Water Quality Monitoring Council
- Wildlife Conservation Board
- Central Valley Flood Protection Board
- Delta Conservancy
- Delta Protection Commission
- Delta Stewardship Council
- Certified Irrigation and Nutrient Management Plans

And Now for more Ugly – Newer Initiatives

- ***40% Unimpaired Flows Plan***
  - Would require 40% of Merced, Toulumne and Stanislaus Rivers to flow to the ocean without any use
  - To help restore salmon populations (about 1000 exist)
  - Could have idled hundreds of thousands of crop land acres
  - In dry year could have restricted some Bay Area cities to just 8 gallons of water per person per day
  - Framework for more sensible replacement, Voluntary Agreements, has angered environmental groups

And Now for the Ugly – Newer Initiatives

- ***Rights of Nature***
  - Growing international movement
  - Provide constitution-type rights to rivers and other ecosystems
  - Enforced by giving entity a bill of rights and guardians who may take legal action to ensure rights are upheld
  - Enormous, ambiguous power grab

Water Issues Facing California Agriculture

- Drought
- Salinization
- Climate Change (?)
- Shifts in Cropping Systems
- Aquifer Restrictions
- New Regulations
- Political Pressure

With all of this in mind many are asking…

Is This What California Ag is Heading For?

Thank You!