

And it never failed that during the dry years the people forgot about the rich years, and during the wet years they lost all memory of the dry years. It was always that way.

East of Eden, John Steinbeck

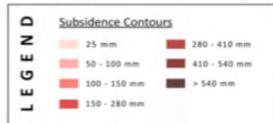
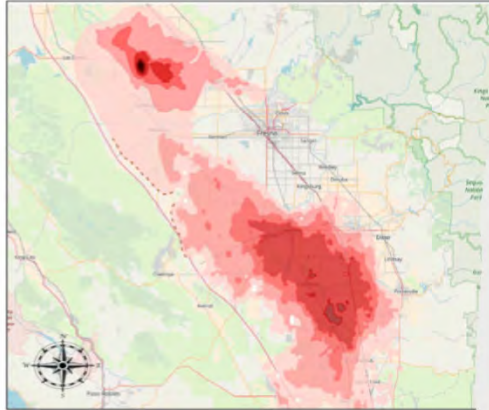
**California's Drought:
Can We Conserve Our
Way Out?"**

- Before we attempt to answer this question, it is important to provide some historical perspective pertaining to the San Joaquin Valley, the Kaweah River Basin and the place I call home, Visalia.
- It started with the Yokots who fished the rivers, sloughs and the Tulare Lake; hunted elk, antelope, rabbits, deer, pigeons on the Valley floor and adjoining foothills while all the while avoiding the mighty grizzly bear, and who established villages along the San Joaquin, Kings, Kaweah, Tule and Kern rivers.
- And then, Manifest Destiny, after spreading across the West began to get a foothold in the San Joaquin Valley.



- **It began with the discovery of gold on Sutter Creek in 1848 and from that point miners, hunters, farmers and cattlemen drifted into the San Joaquin Valley seeking land, a homestead and a place to carve out a living.**
- **From the 1850s through 1865 cattle was king until a 200-year storm event in 1861/62 drowned thousands of cattle and flooded the entire Valley. A drought that followed the "Big Flood" took care of the rest of the livestock.**
- **In the 1870s wheat dominated the Valley floor. It required only rain, a team of horses and some elementary machinery.**
- **Wheat was replaced with a myriad of crops when the farmer discovered that river water could be diverted to non-riparian land through ditches and canals. The Wright Act was born in 1877, creating irrigation districts and ditch companies that formalized the dispersal of surface water over much of the Valley floor.**
- **From 1872 to 1876, the Southern Pacific Railroad extended its tracks through the Valley from Stockton to Los Angeles. The Railroad introduced irrigation technology, created small farms and cities through its real estate division and provided a means to ship agricultural goods to far away markets.**

San Joaquin Valley Land Subsidence (2008-2010)



Consulting

Source: <https://ca.water.org>

- Once most of the streams, rivers and creeks had been diverted to non-irrigated lands, the Artesian wells had lost their pressure to push water to the surface, and the great Tulare Lake, once the largest lake west of the Mississippi, had begun its shrinking process, wells were plunged into the aquifer that laid below the Valley floor.

- There were small wells that reached down to 50 feet for the rural homestead and 1500 feet for the corporate farming interests.

- The wells along with surface water rights started the evolution for what would become the greatest farming region in the world. These waters created the citrus thermal belt along the foothills, stone fruit orchards along the Kings River, cotton on the west side the Valley floor, and finally, nuts where field crops once existed but did not provide a good return.

- And then, the ground started to sink and sink and sink. Called subsidence, it reduced the land's ability to recharge groundwater, it caused well casings to crack, roads to fail, and canals to lose their ability to transport water. For example, under the Tulare Irrigation District the ground water dropped from 22 feet in 1922 to 50 feet in 1946.

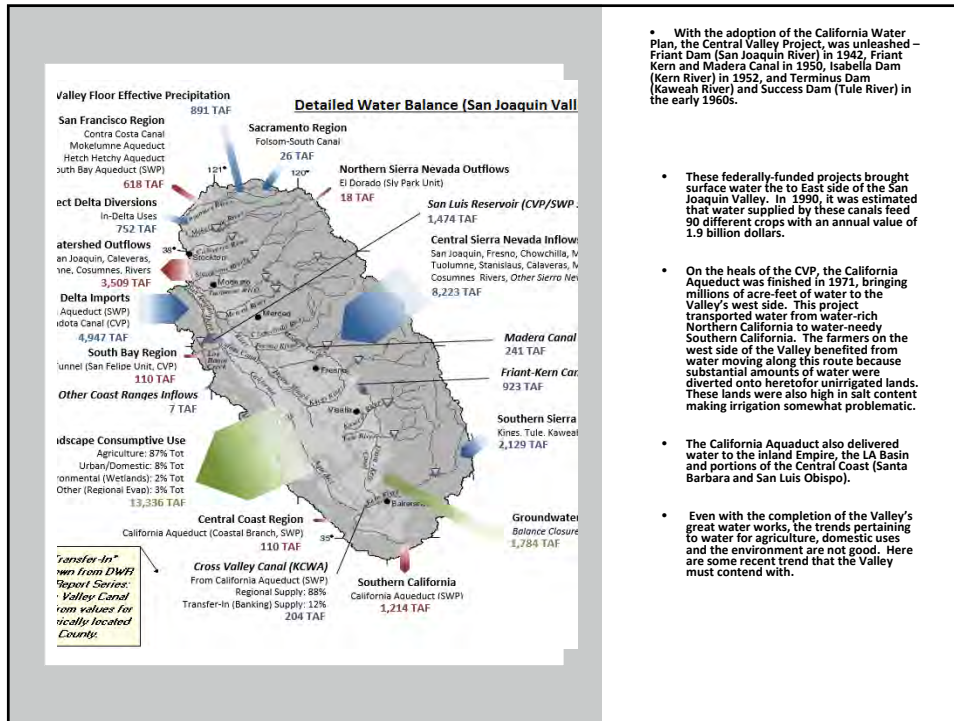
- The impact was significant and irreversible.

- From this environmental tragedy, the California Water Plan (1933) was born to save the farmer, the agricultural economy and the Valley's water bank account, the Aquifer.

Groundwater & Land Subsidence in California



- The Friant-Kern Canal began to experience subsidence due to aggressive pumping of ground water near the Tulare/Kern County line. This subsidence has significantly reduced the flow of irrigation water from the county line to southern Kern County. The fix will be in the hundreds of millions.



Decisions, legislation, environmental changes and technological advancements that have shaped the water environment in the San Joaquin Valley over the last 50 years

Legislation

During the 2015–2016 fiscal year, proposed emergency amendments to the 2013 CALGreen. Facing historic drought conditions, the State of California was charged with finding additional ways to further reduce the use of potable water. California Department of Water Resources' (DWRs') proposed a Model Water Efficient Landscape Ordinance (MWEL0). Also, an opportunity to reduce indoor water use was implemented through the requirement to install reduced flow faucets and reduced flush volume urinals.

In concordance with the Sustainable Groundwater Management Act (SGMA) Regulations adopted in 2014, each Groundwater Service Area in the Kaweah Subbasin is to provide an annual report to California's Department of Water Resources (DWR) by April 1 of each year following the adoption of the first Groundwater Sustainability Plan (GSP) which includes data from the previous Water Year (WY). The Annual Report will document the groundwater conditions within the Subbasin for WY 2020, the status of the GSP implementation, and the trend towards achieving the interim milestones.

Legal Opinions

The San Joaquin River Restoration Settlement was adopted in 2012. This action ensured that flows downstream from Friant Dam were sufficient to maintain salmon fisheries downstream among other objectives, such as saltwater intrusion. It also reduced flows down the Madera and Friant-Kern Canals.

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Technology

Irrigation efficiency in the farming community has become more water conservation oriented over the last 50 years.

1. Drought-Resistant Seeds

Biotech companies are using advanced genomics to create seeds for crops that need less water and are more tolerant of drought conditions. For example, drought resistant crops may have deeper roots or [stomata that close sooner](#) to hold more moisture.

2. Drip Irrigation

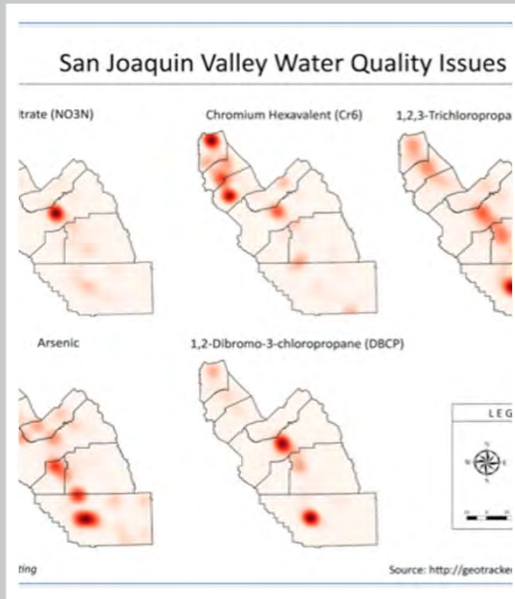
Drip irrigation allows for precise control of the application of water and fertilizer, which can greatly reduce the amount of water needed for crop irrigation. Although it can cost up to [\\$1 million](#) to install, many farmers are seeing the appeal of saving water which can be used to plant more crops or reduce costs. As of 2010, [43%](#) of California farmland still used some form of gravity irrigation but this is down from [70%](#) in 1991.

3. Measuring Water Flow

Precise measurement of water usage with [water flowmeters](#) can prevent overwatering and reduce costs for farmers. As water resources become more limited and expensive it will be more important to have accurate data on how much water is being used to irrigate. Additionally, soil sensors can track soil moisture to determine how much water should be used and allow farmers to make water-saving adjustments.

4. Data Analytics

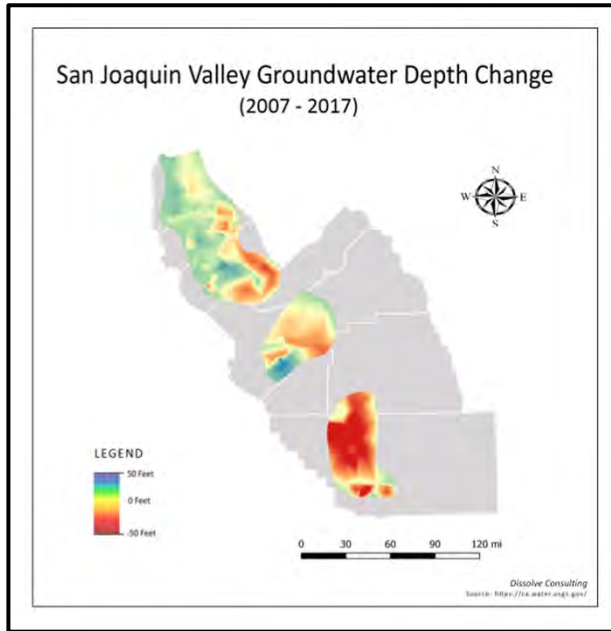
New software products that crunch large amounts of data can provide farmers with important information that they previously didn't have access to. Using data such as local weather as well as data collected from their equipment, farmers can receive recommendations and better understand how much water is needed to optimize production while minimizing water waste.



• Environmental Changes

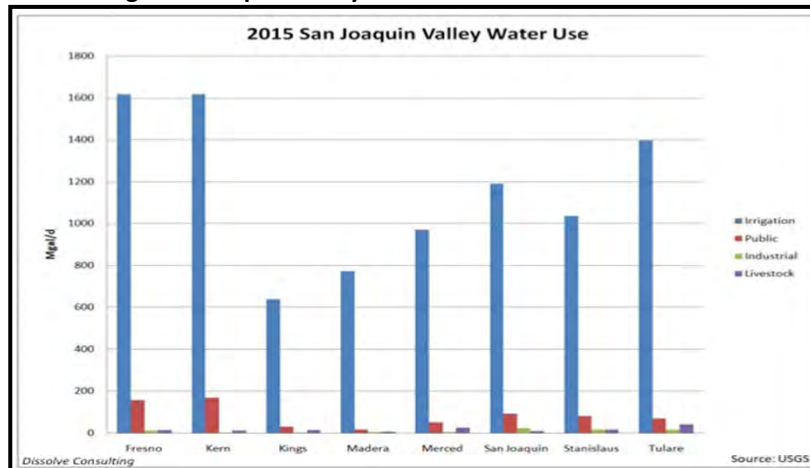
- In addition to the "land" subsiding, falling water tables caused domestic and agricultural wells to begin to pull up toxic chemicals most of which were applied to the land in the form of herbicides, insecticides or fertilizers.
- Dropping water tables, in addition to causing subsidence, severely impacted the farming community due to abandoned wells, extending the depth of wells, and installing larger pumps on existing wells.

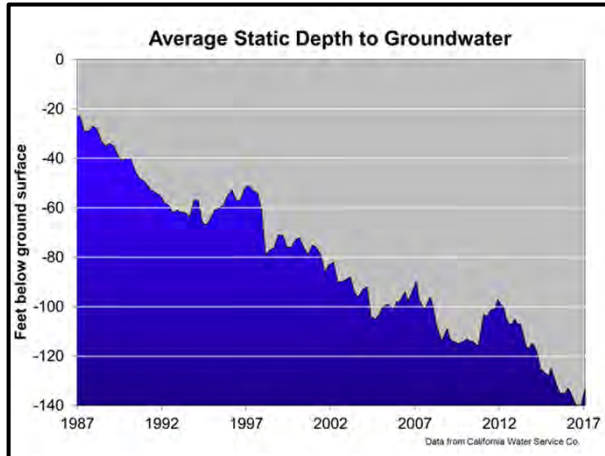
San Joaquin Valley Groundwater Depth Change
(2007 - 2017)



California's Drought: Can We Conserve Our Way Out?" No!

The following charts explains why.





The depth to groundwater under the city of Visalia.

In the Kaweah Subbasin in Tulare County in 2020, agriculture consumed 92 percent of basin's groundwater and 99 percent of the basin's surface water.

Table ES-1 Kaweah Subbasin Total Water Use Summary

Source	Total	Agriculture	M&I
2019			
Groundwater	685,700	603,900	81,800
Surface Water	691,400	689,400	2,000
Total	1,377,100	1,293,300	83,800
2020			
Groundwater	1,022,700	940,000	82,700
Surface Water	208,000	205,900	2,100
Total	1,230,700	1,145,900	84,800

Note: All values rounded to nearest 100 Acre-Feet (AF).

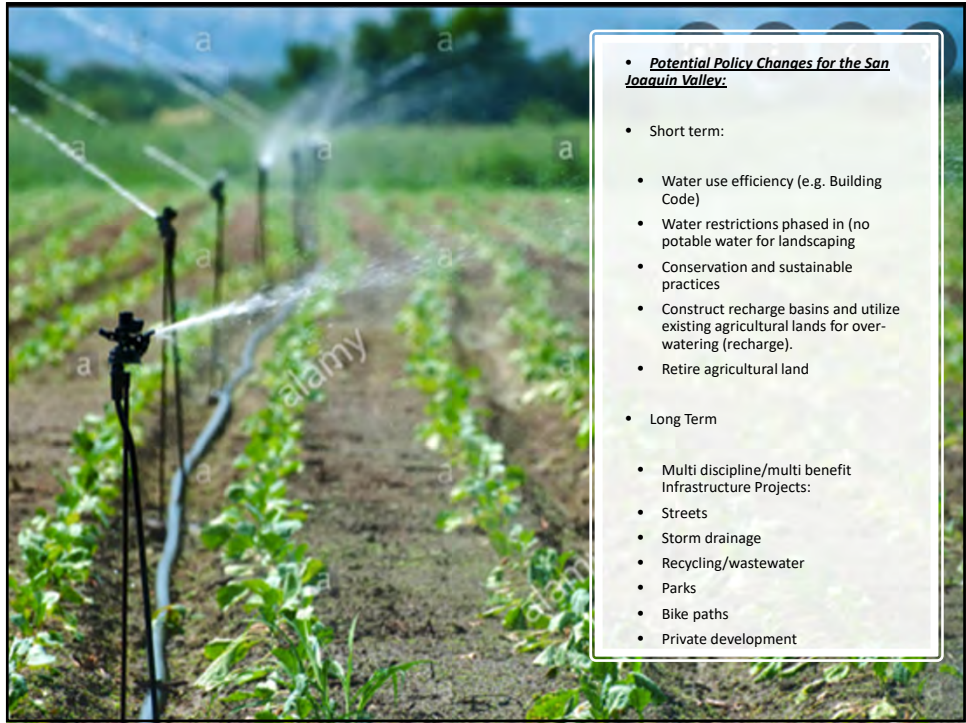
M&I includes Urban, small systems, rural domestic and industrial uses

Table ES-2 Kaweah Subbasin Change in Groundwater Storage

Water Year	Rainfall*		Water Period	Change in Storage
	Inches	% of Average		
2019	10.74	112%	Wet	209,000
2020	8.03	84%	Dry	-418,000

Note: Change in storage values rounded to nearest 1,000 Acre-Feet (AF).

*Rainfall based from Visalia NOAA station



- **Potential Policy Changes for the San Joaquin Valley:**
- Short term:
 - Water use efficiency (e.g. Building Code)
 - Water restrictions phased in (no potable water for landscaping)
 - Conservation and sustainable practices
 - Construct recharge basins and utilize existing agricultural lands for over-watering (recharge).
 - Retire agricultural land
- Long Term
 - Multi discipline/multi benefit Infrastructure Projects:
 - Streets
 - Storm drainage
 - Recycling/wastewater
 - Parks
 - Bike paths
 - Private development

Examples for cities

Cameron Avenue "Before"

- Street is wide
- Encourages high speeds
- Less shade: hot and unpleasant to walk or cycle on
- Generates high stormwater runoff

Cameron Avenue "After"

- Narrower street reduces traffic speeds
- Reduces storm water runoff
- Shade trees reduce heat buildup
- Shade makes it more pleasant to walk and cycle
- Improved aesthetics

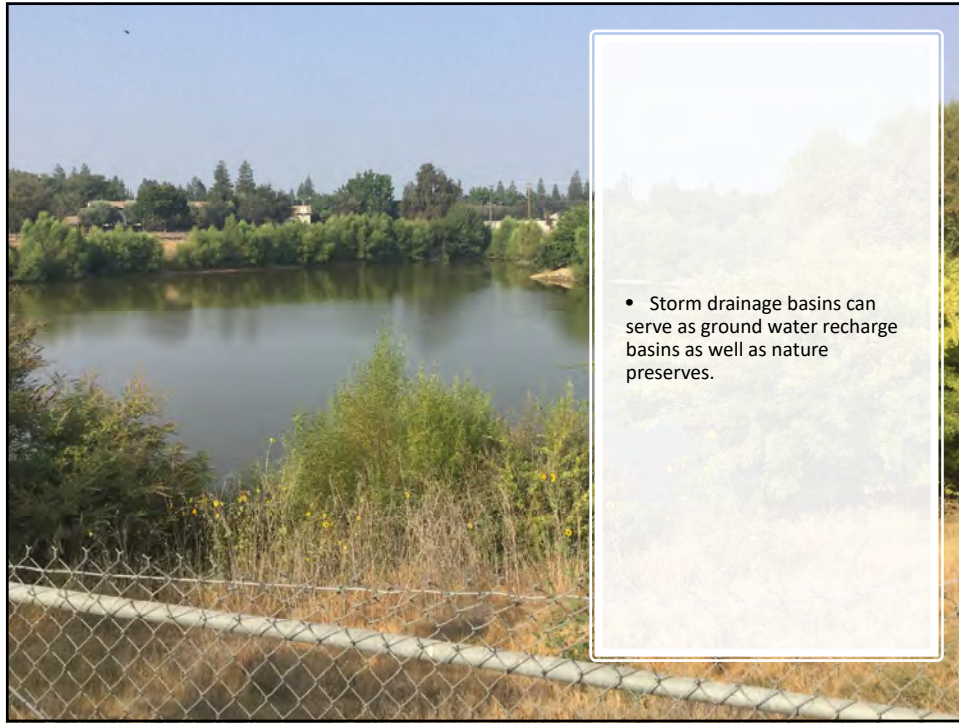
Traditional Storm Drain Design



Low Impact Development design



- Diversify water sources to increase water system resiliency.
- Diversified solutions were encouraged by statewide performance targets and tight regulation around water quality and public health.
 - Rainwater harvesting
 - Stormwater capture and use
 - Manage aquifer recharge
- Diversify, then use "Fit for Purpose" approach
 - Potable for drinking
 - Manage aquifer recharge for irrigation
 - Storm water capture for urban forest
 - Rainwater capture for outdoor landscaping



Questions?

