Glenn County Reconnaissance-Level Groundwater Sustainability Risk Assessment

Davids Engineering, Inc.

December 11, 2017

Background and Context

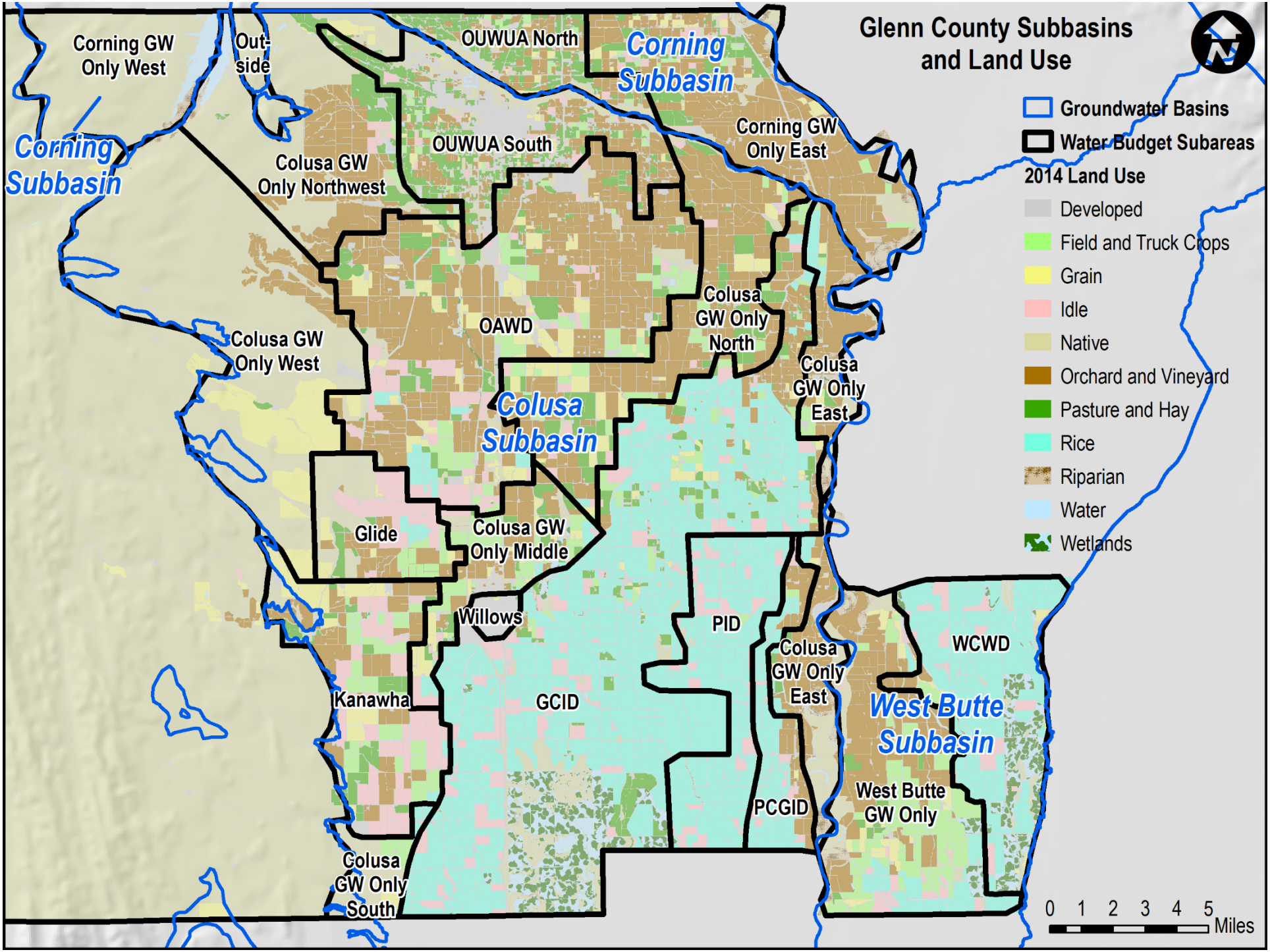
- High level assessment of potential sustainability challenges under SGMA
- Funded jointly by Glenn County agencies
- Originally completed in spring 2017 during GSA formation
- Recently updated to reflect 2017 conditions
- Directly supports current Stressed Basin grant effort
- Directly supported GSP grant applications

Outline

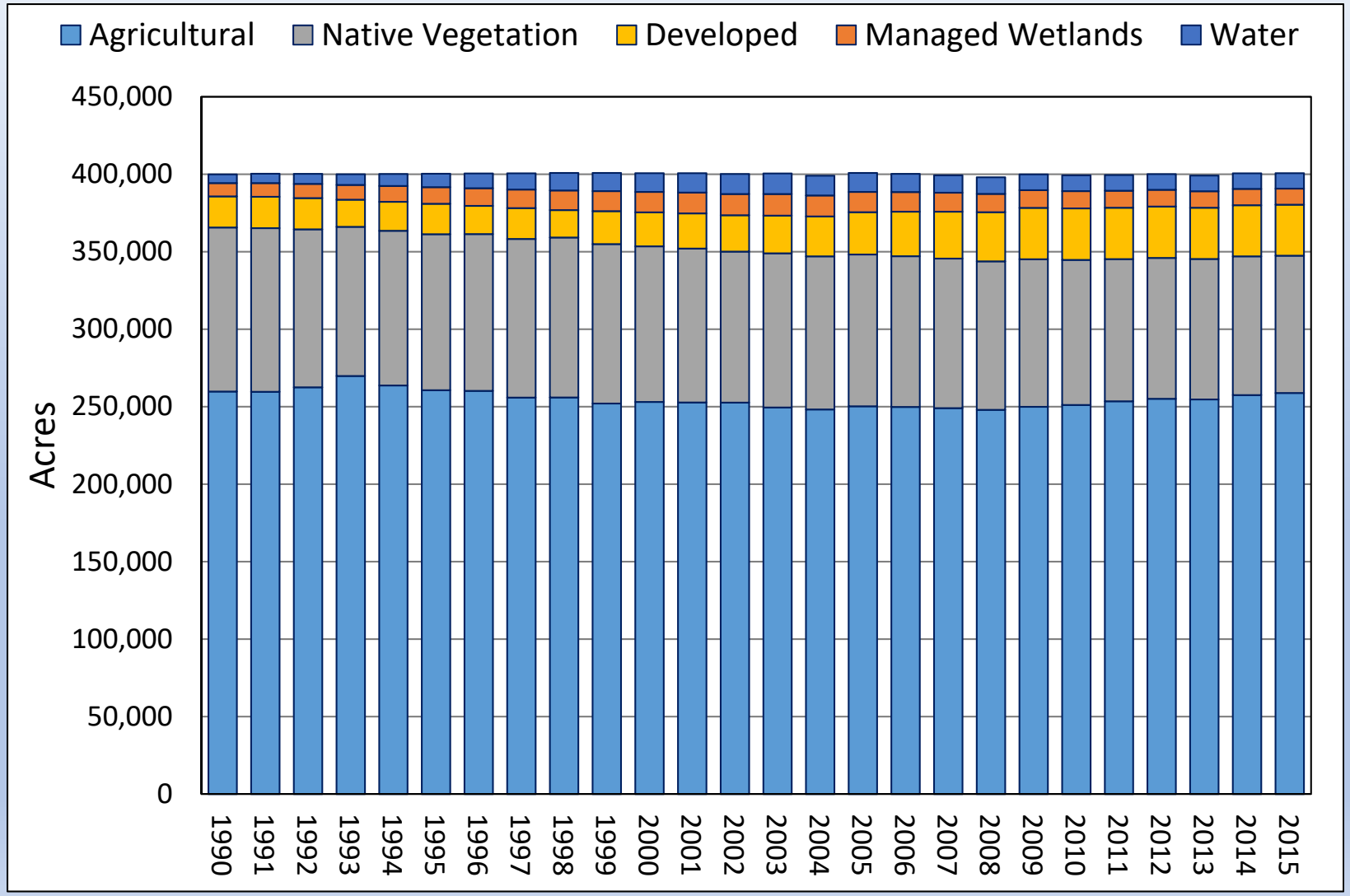
- Glenn County Setting
- Key Decisions Embedded in GSP Development
- Sustainability Assessment by Groundwater Sustainability Indicator
  - Look into the Crystal Ball
  - Identify likely approach to address in GSP
- Questions & Answers, Discussion

Notes and Ground Rules

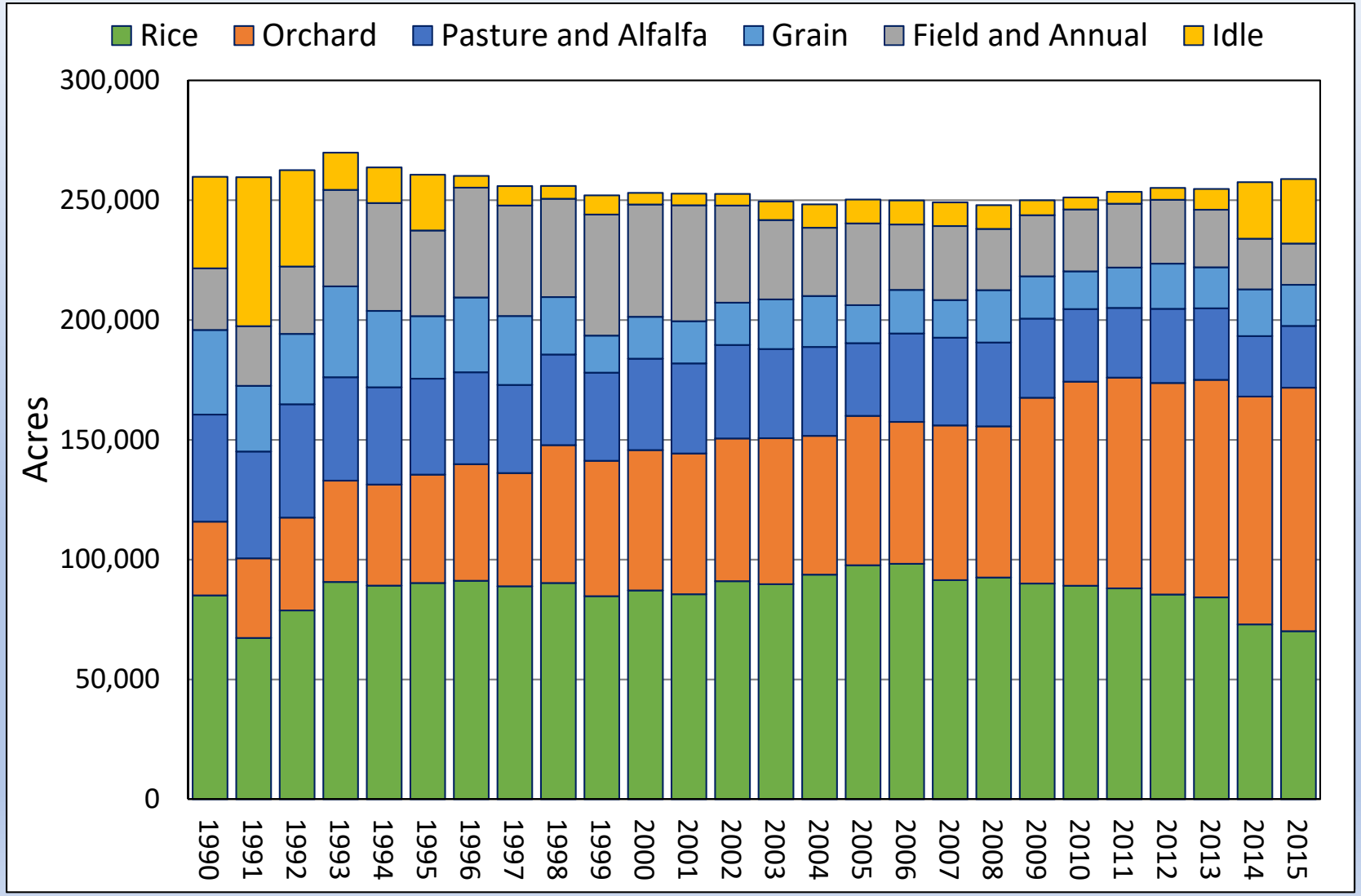
- Publicly available data sources used primarily
- Judgment necessarily involved; feel free to disagree, draw your own conclusions
- Acknowledge uncertainty in numbers
- Covering a wide technical range
- Stops along the way for questions and discussion


Glenn County Subbasins and Land Use
Groundwater Basins
Water Budget Subareas
2014 Land Use
Developed
Field and Truck Crops
Grain
Idle
Native
Orchard and Vineyard
Pasture and Hay
Rice
Riparian
Water
Wetlands
Corning Subbasin
Corning GW Only West
Out-side
OUWUA North
Corning Subbasin
Corning GW Only East
OUWUA South
Colusa GW Only Northwest
OAWD
Colusa GW Only North
Colusa GW Only East
Colusa GW Only West
Colusa Subbasin
Glide
Colusa GW Only Middle
Willows
PID
Colusa GW Only East
WCWD
Kanawha
GCID
West Butte Subbasin
PCGID
West Butte GW Only
Colusa GW Only South
0 1 2 3 4 5 Miles

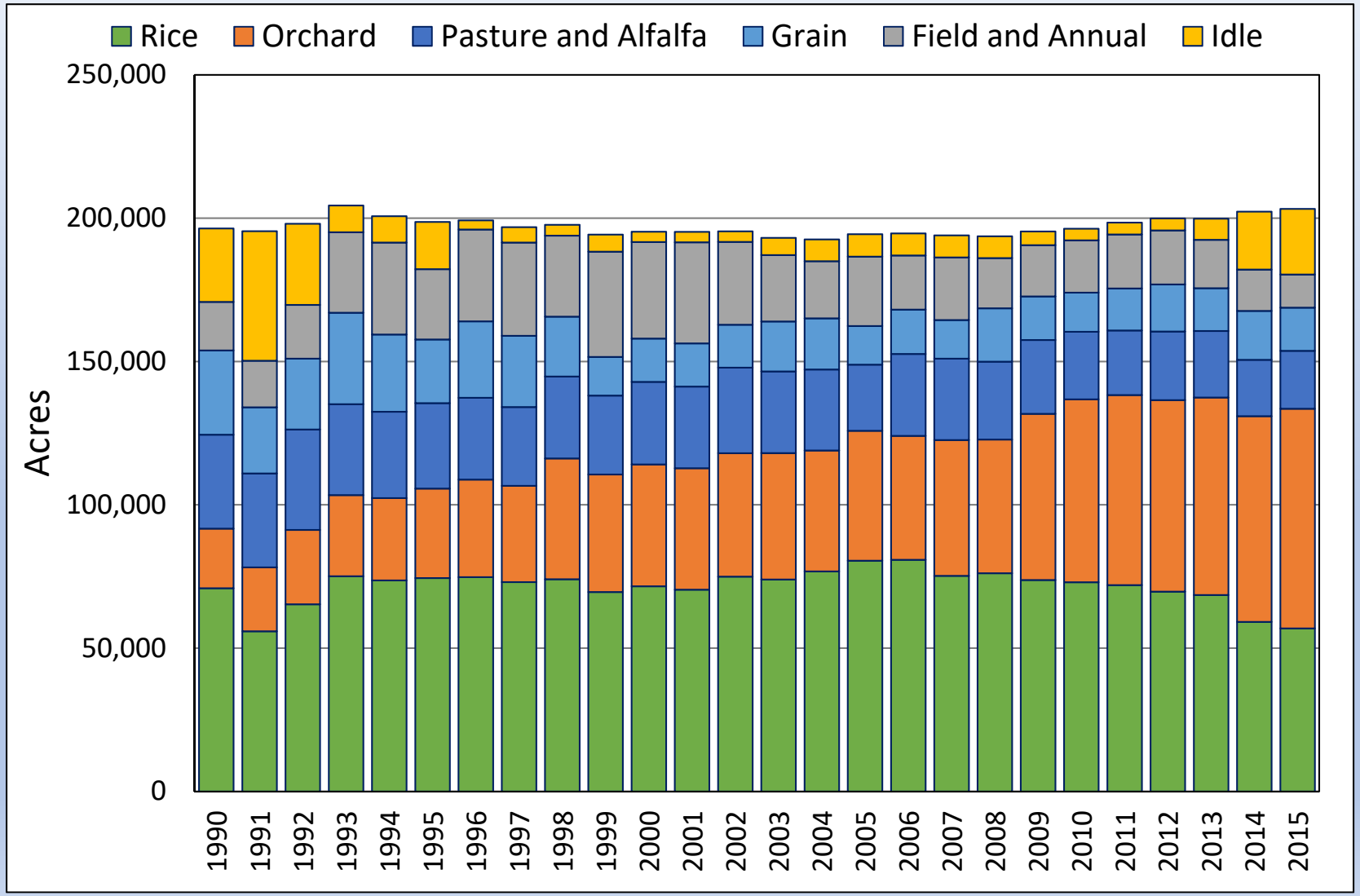
Glenn County Regional Setting: Valley Floor General Land Use Trends



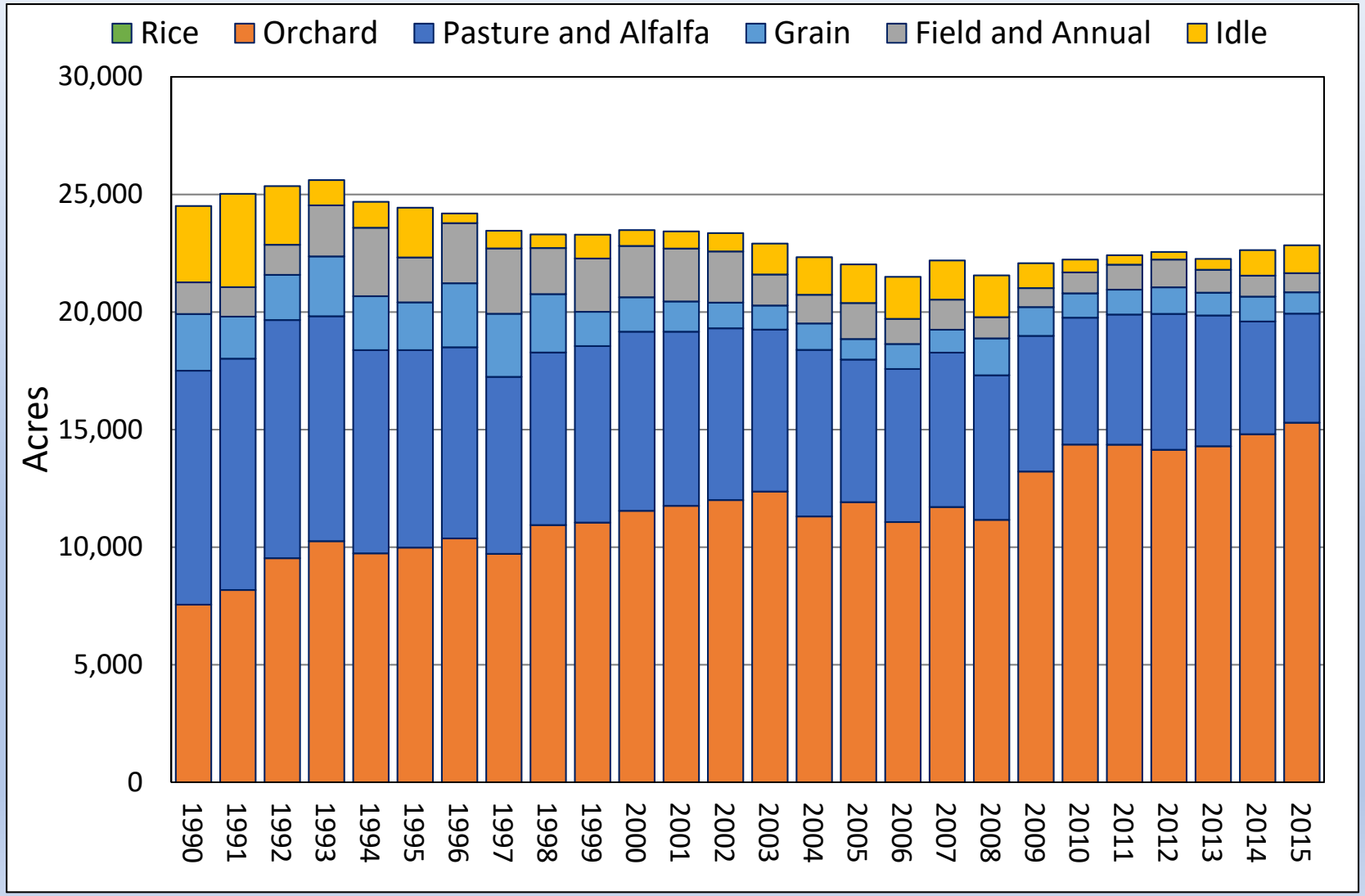
Glenn County Regional Setting: Valley Floor Agricultural Land Use Trends



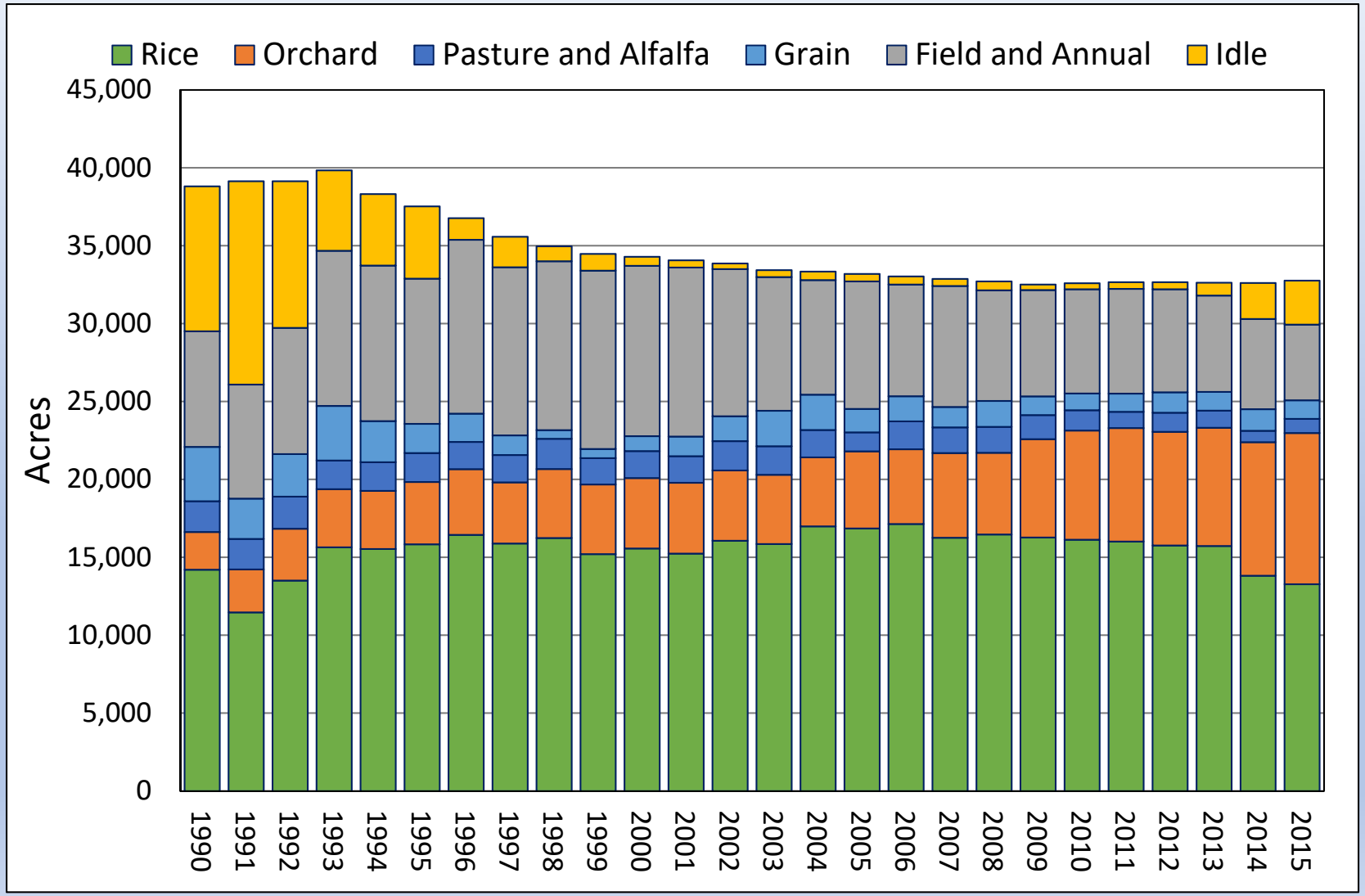
Colusa Subbasin: Agricultural Land Use Trends



Corning Subbasin: Agricultural Land Use Trends

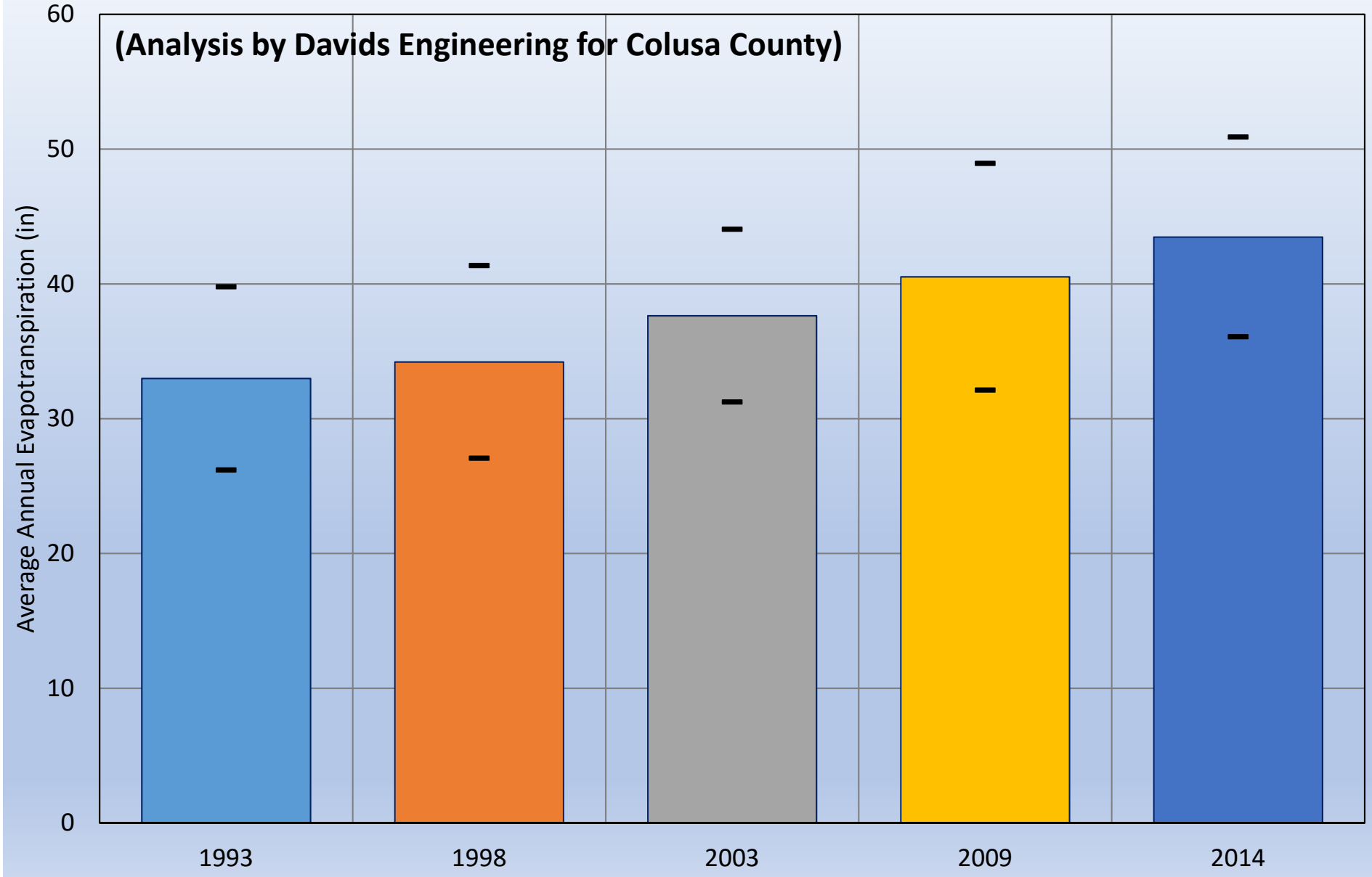


West Butte Subbasin: Agricultural Land Use Trends

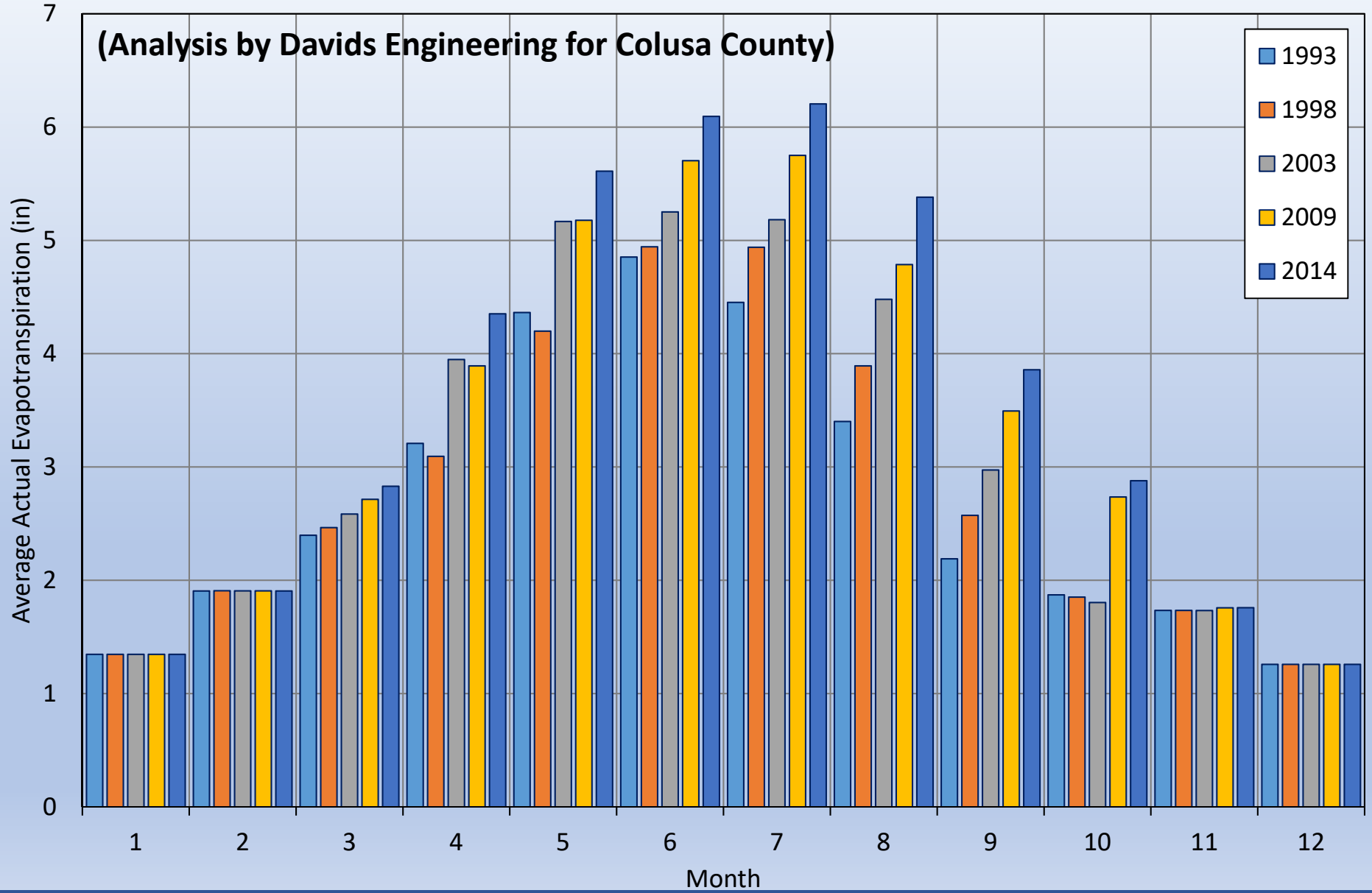


Almond Annual Evapotranspiration

(Black dashes represent standard deviation)



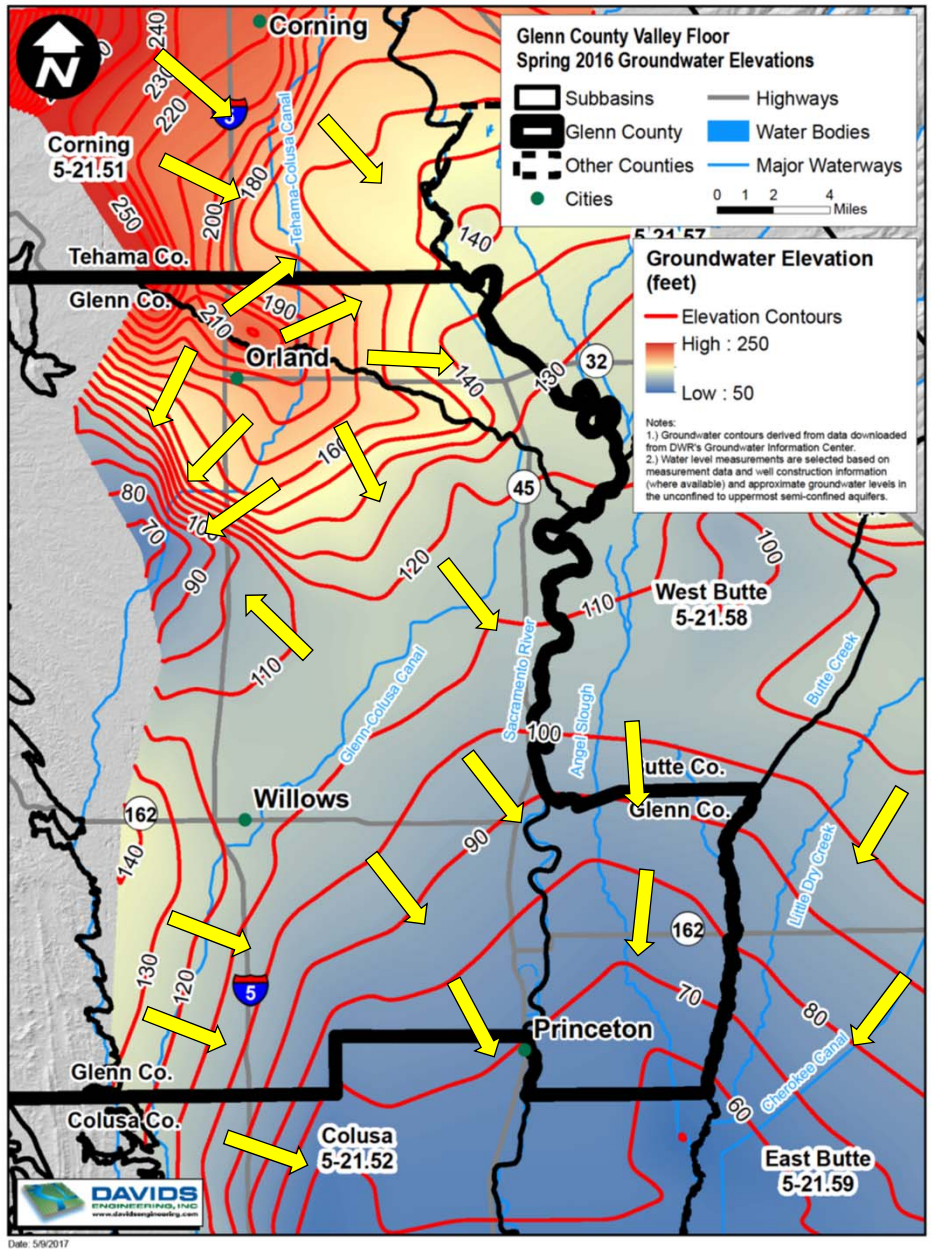
Almond Monthly Evapotranspiration



Glenn County Regional Setting

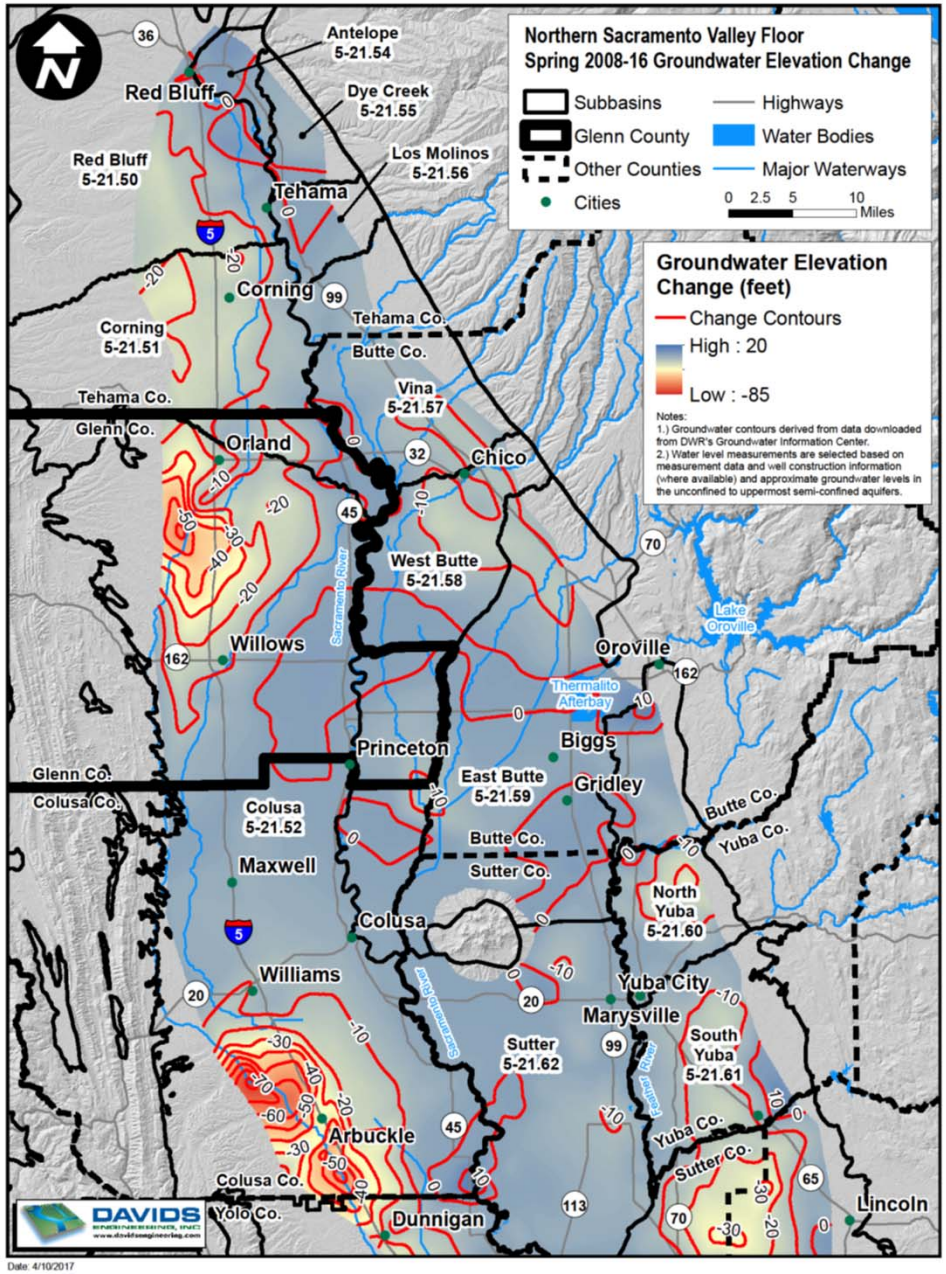
County	Subbasin Area (Acres)			Total by County
	Colusa	Corning	West Butte	
Butte	573	773	93,034	94,380
Colusa	397,615	0	42,409	440,024
Glenn	**305,388**	**44,851**	**44,971**	**395,210**
Sutter	93	0	14	107
Tehama	1	161,262	0	161,263
Yolo	1,500	0	0	1,500
Total by Subbasin	705,170	206,886	180,429	1,092,484

395,210 Acres in Glenn County Overlying Alluvial Basins Subject to SGMA



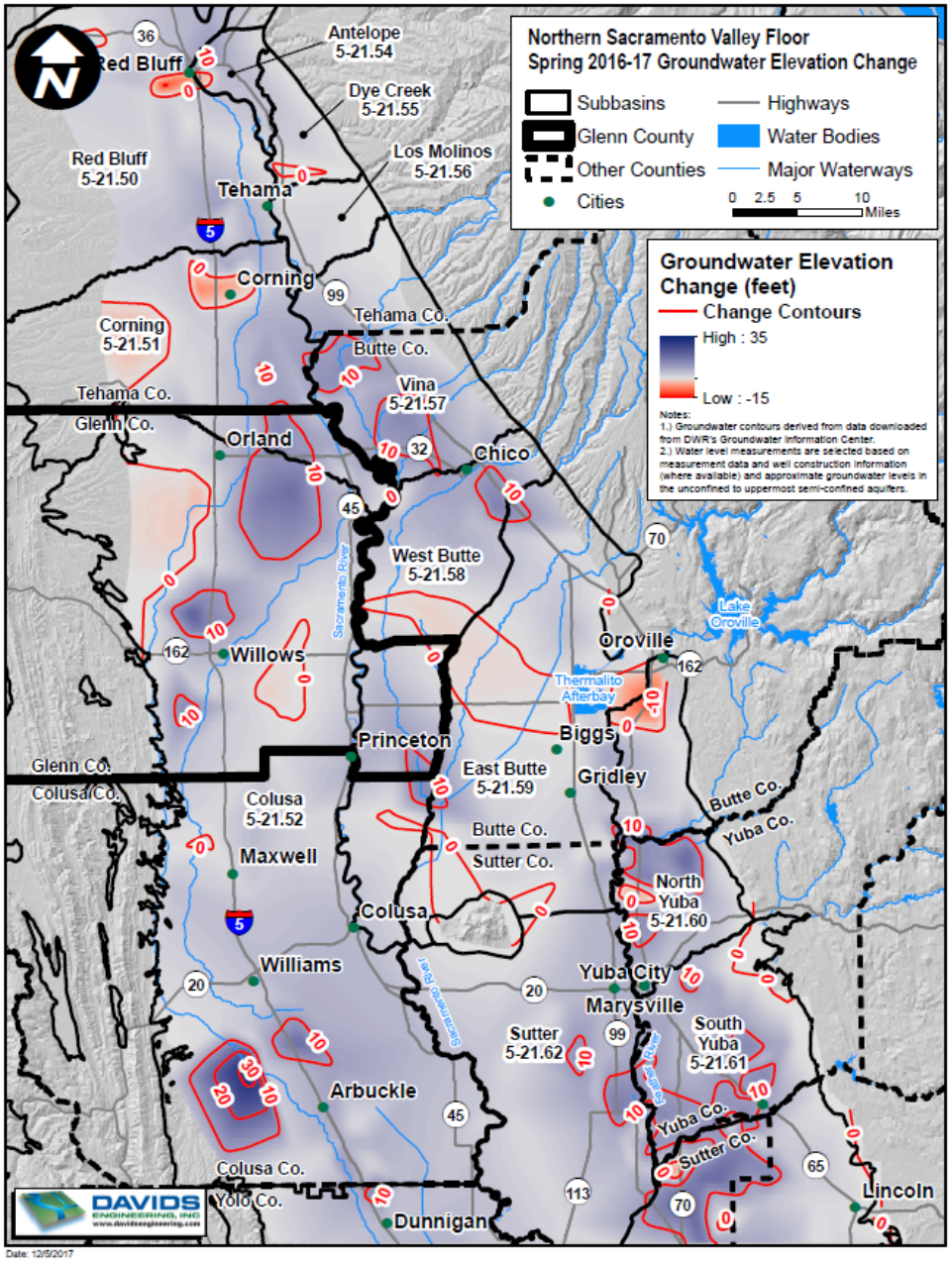
Glenn County Regional Setting: Groundwater Elevation Change 2008 to 2016

Data Source: DWR Groundwater Information Center. Water level measurements are from wells in the unconfined to uppermost semi-confined aquifers. (Generally corresponding to wells depths between 100 and 450 feet.)



Glenn County Regional Setting: Groundwater Elevation Change 2016 to 2017

Data Source: DWR Groundwater Information Center. Water level measurements are from wells in the unconfined to uppermost semi-confined aquifers. (Generally corresponding to wells depths between 100 and 450 feet.)



Key Decisions Embedded in GSP Development

- Setting criteria for how the basin will be sustainably managed
  - Defining "Undesirable Results": do they exist now; will they potentially occur in the future?
  - Creating "Management Areas" within which "Sustainability Criteria" will be defined
  - Establishing "Minimum Thresholds" and "Measureable Objectives" for each Sustainability Indicator
- Deciding how sustainability will be achieved
  - What Projects and Management Actions may be required?
  - Where?
  - Cost and who pays?

SGMA Sustainability Indicators

1) Chronic Lowering of Groundwater Levels
2) Reduction of Groundwater Storage
3) ~~Seawater Intrusion~~
4) Degraded Water Quality
5) Land Subsidence
6) Depletions of Interconnected Surface Water

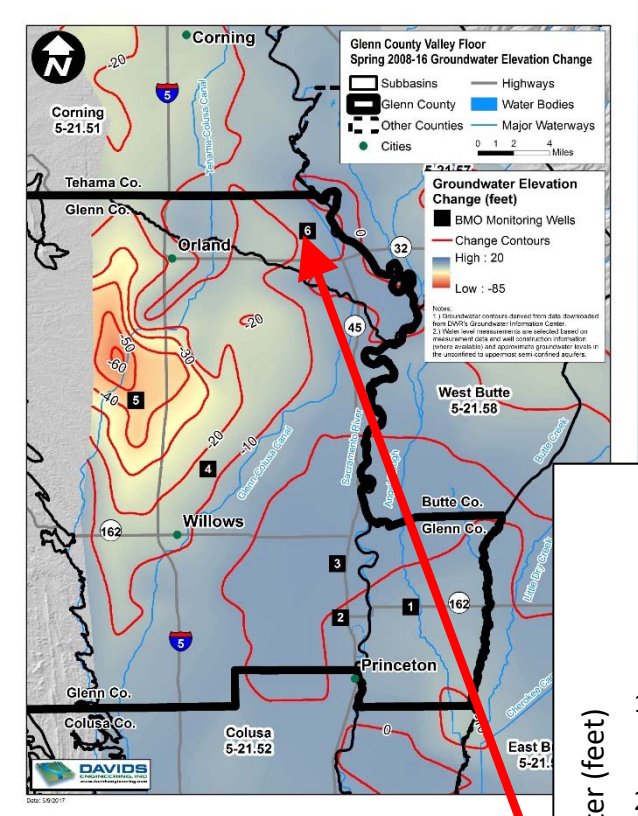
Undesirable Results

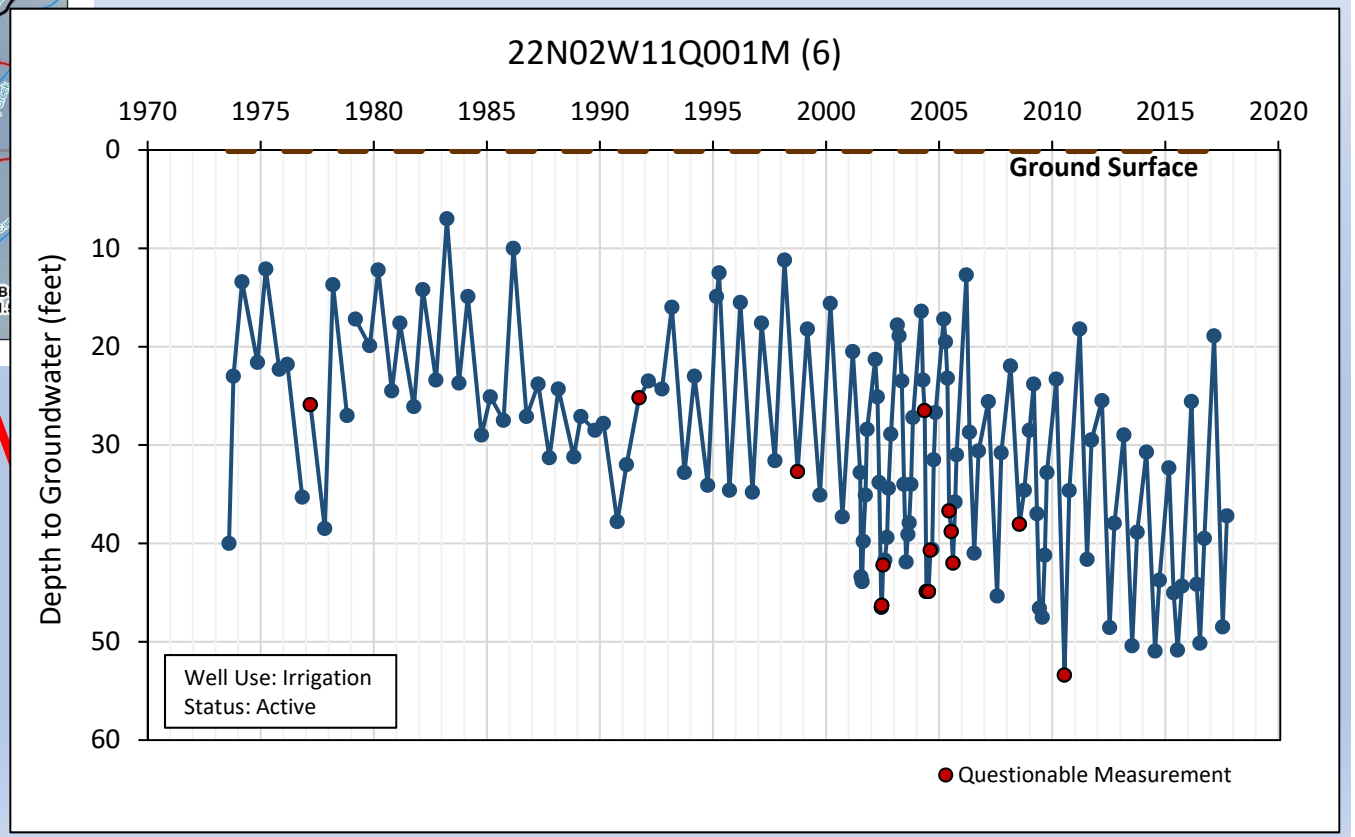
- GSPs may, but are not required to, address undesirable results that occurred before, and have not been corrected by, January 1, 2015 (per authorizing legislation; not expressed in GSP regs)
- An agency that is able to demonstrate that undesirable results…are not present and are not likely to occur…shall not be required to establish criteria (in the GSP) (§354.26)

Sustainability Indicator #1
Chronic Lowering of Groundwater Levels

- Minimum Threshold: "…the groundwater elevation indicating a depletion of supply at a given location that may lead to undesirable results." § 354.28 (c) (1)
- Potential Undesirable Results:
  - Well stranding
  - Increased well construction costs
  - Increased groundwater pumping costs
  - Induced water quality degradation
  - Inelastic land subsidence
  - Streamflow depletion
  - Impacts to Groundwater Dependent Ecosystems
  - Others?

Sustainability Indicator #1
Chronic Lowering of Groundwater Levels





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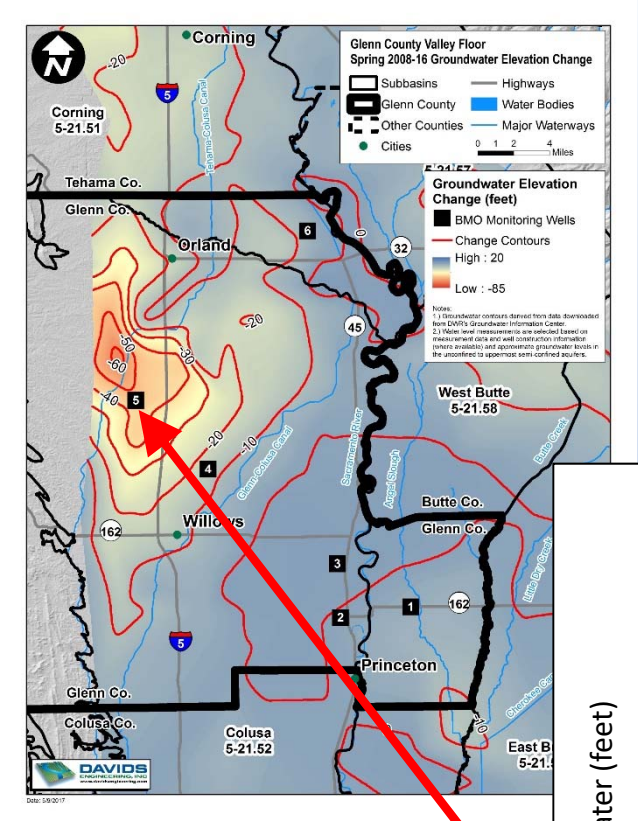

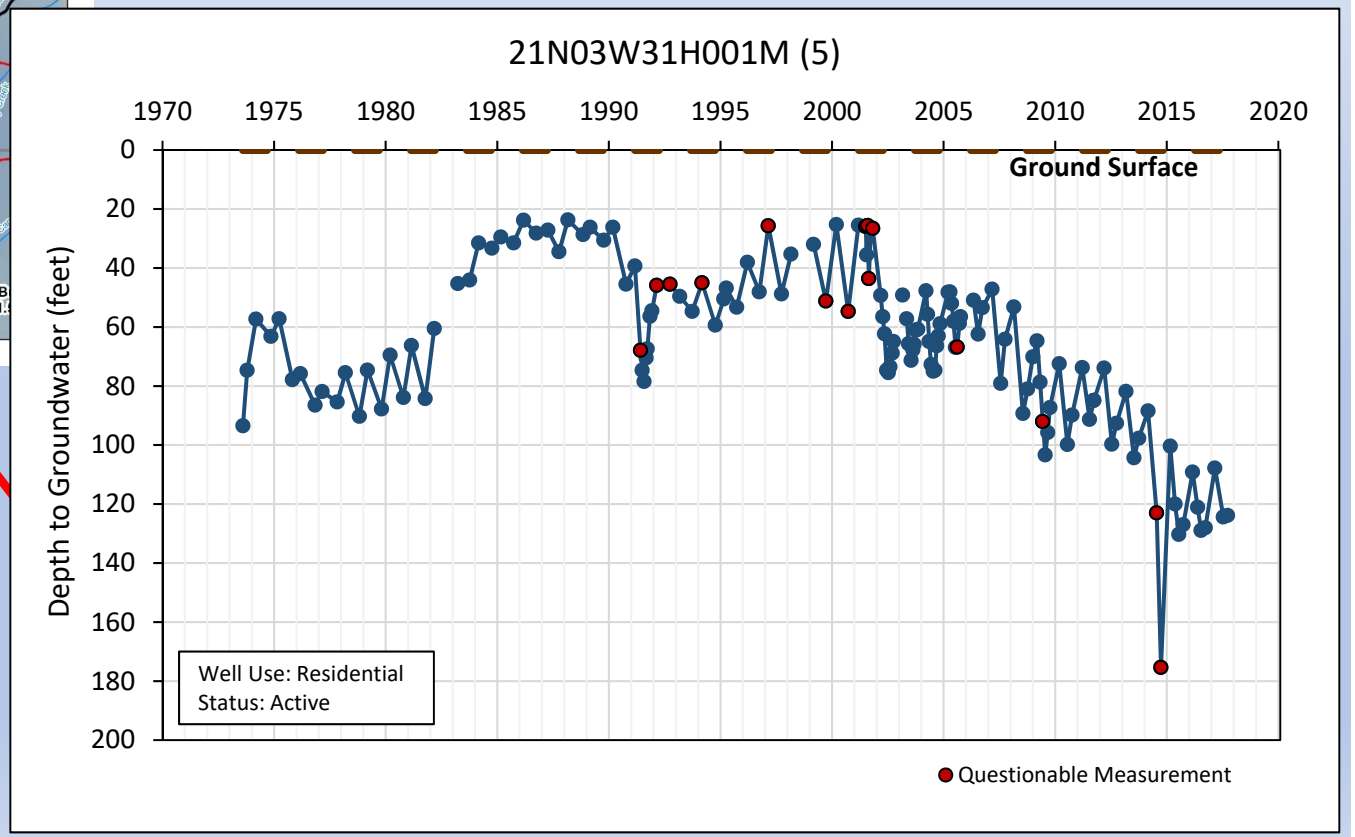

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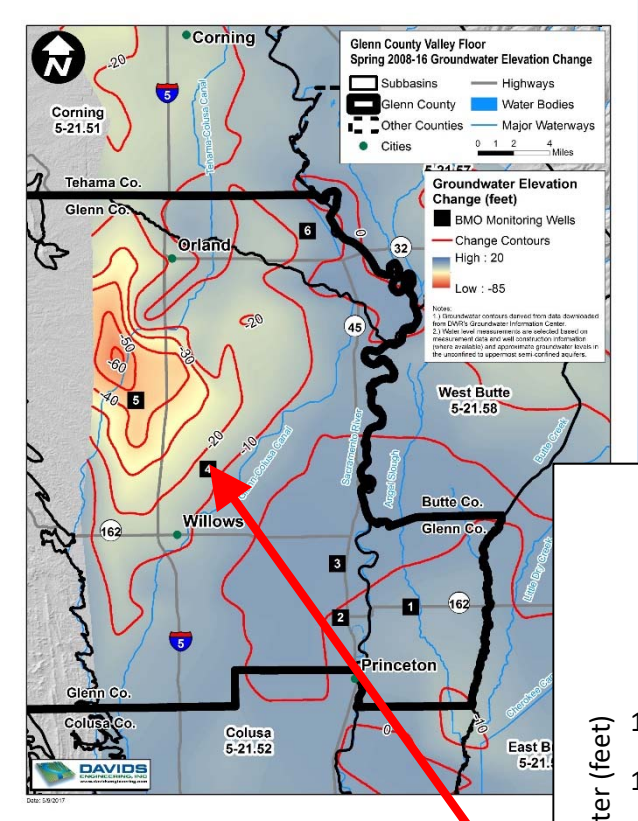

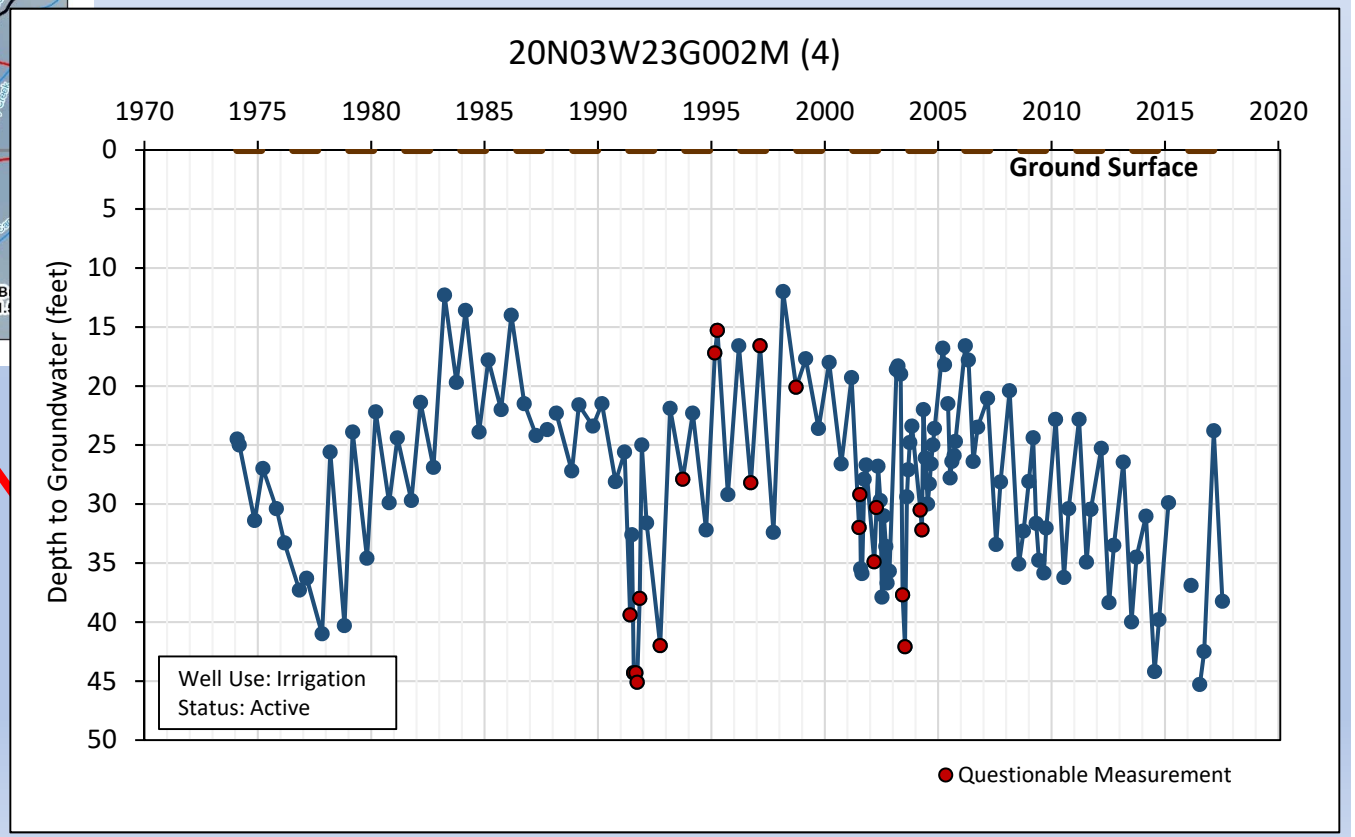

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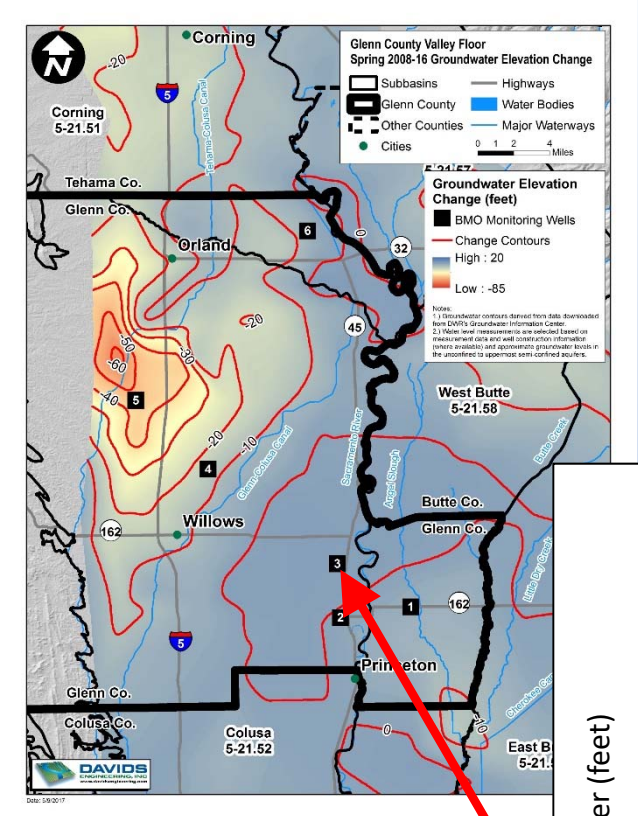

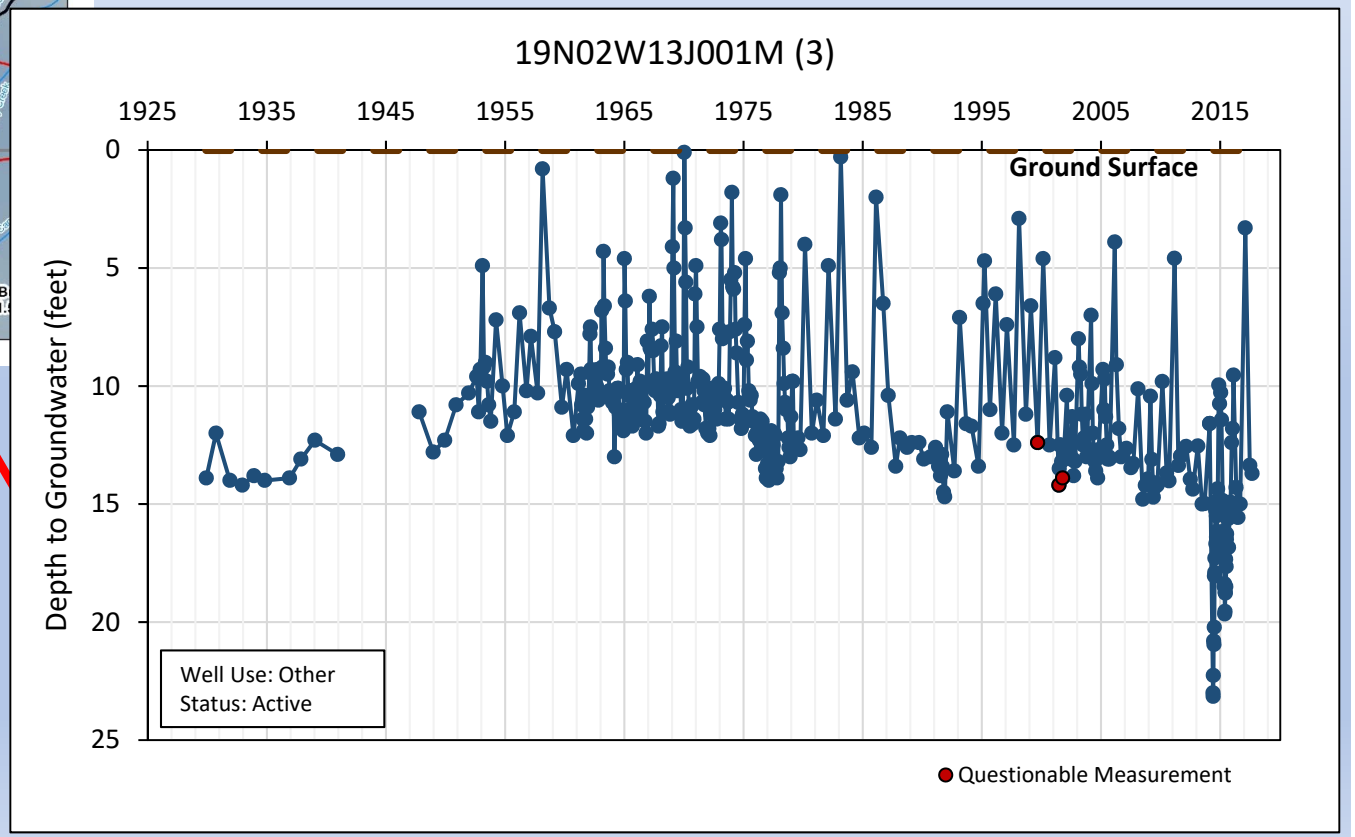

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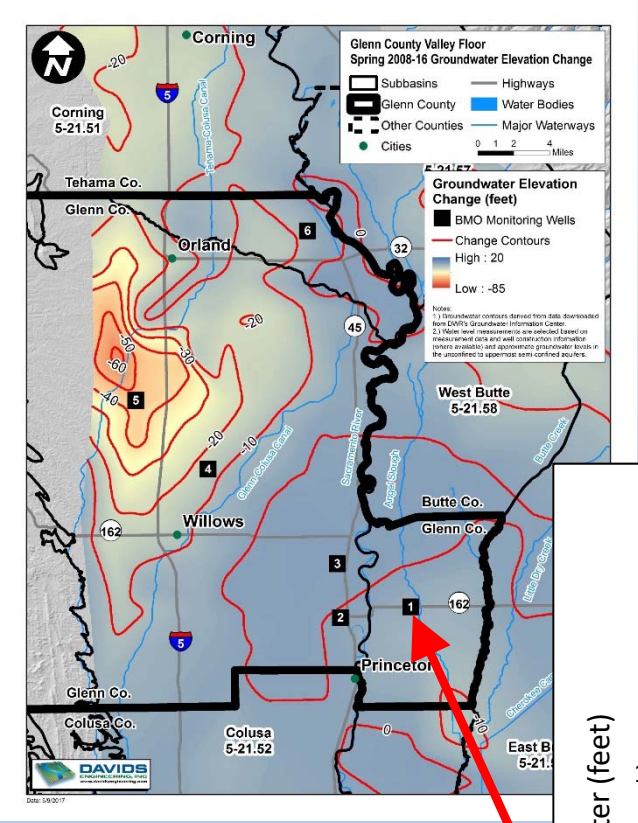
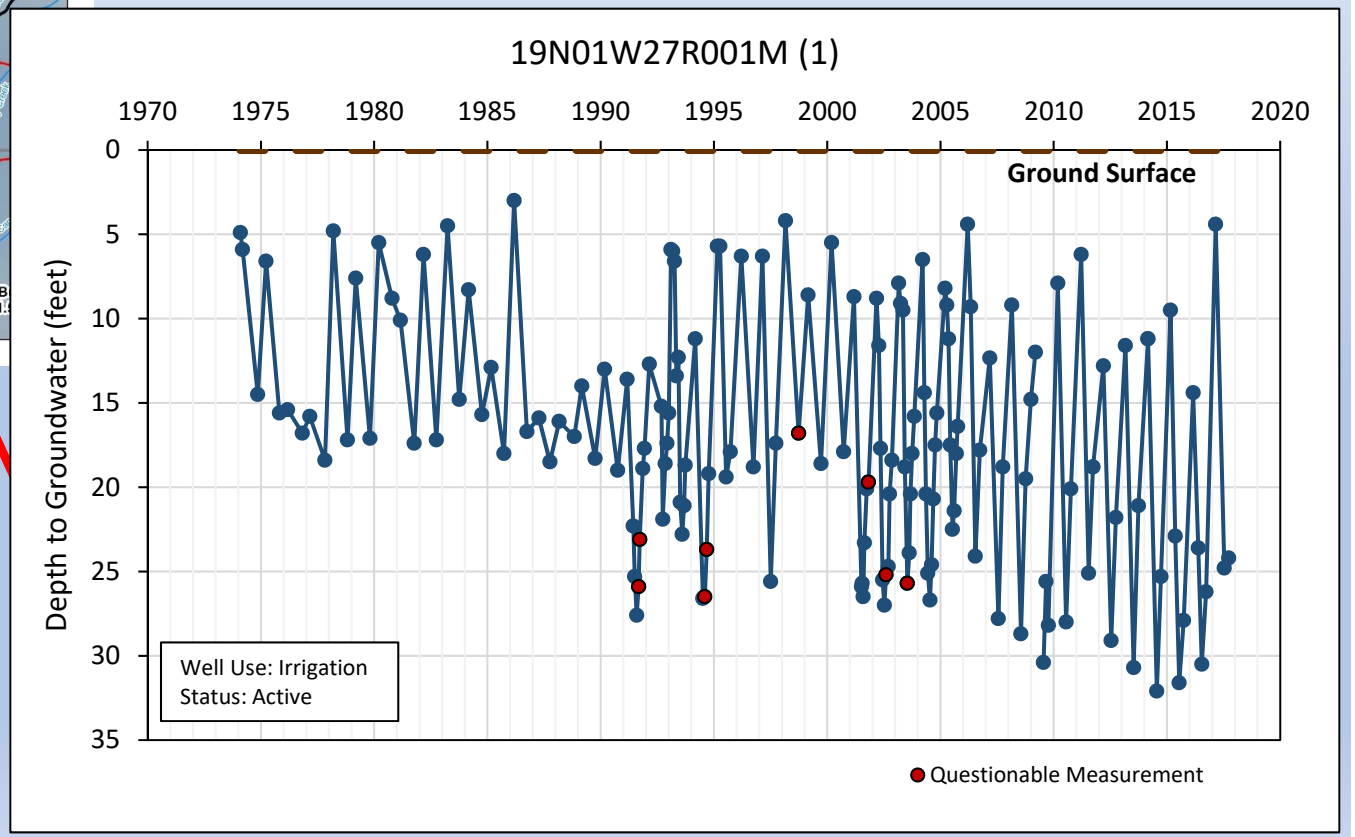




Sustainability Indicator #1
Chronic Lowering of Groundwater Levels

Conclusions:

- Will definitely need to be addressed in GSP, with focus on west side
- Minimum Thresholds, Measureable Objectives and Interim Milestones will need to be established in the GSP
  - At what elevations do results become undesirable?
- Projects and Management Actions may need to be identified in GSP if levels continue to decline

Sustainability Indicator #2: Reduction of Groundwater Storage

- Minimum Threshold: "…a total volume of groundwater that can be withdrawn from the basin without causing conditions that may lead to undesirable results." § 354.28 (c) (2)
- Potential Undesirable Results:
  - Reduced water supply reliability (reduced drought reserves)

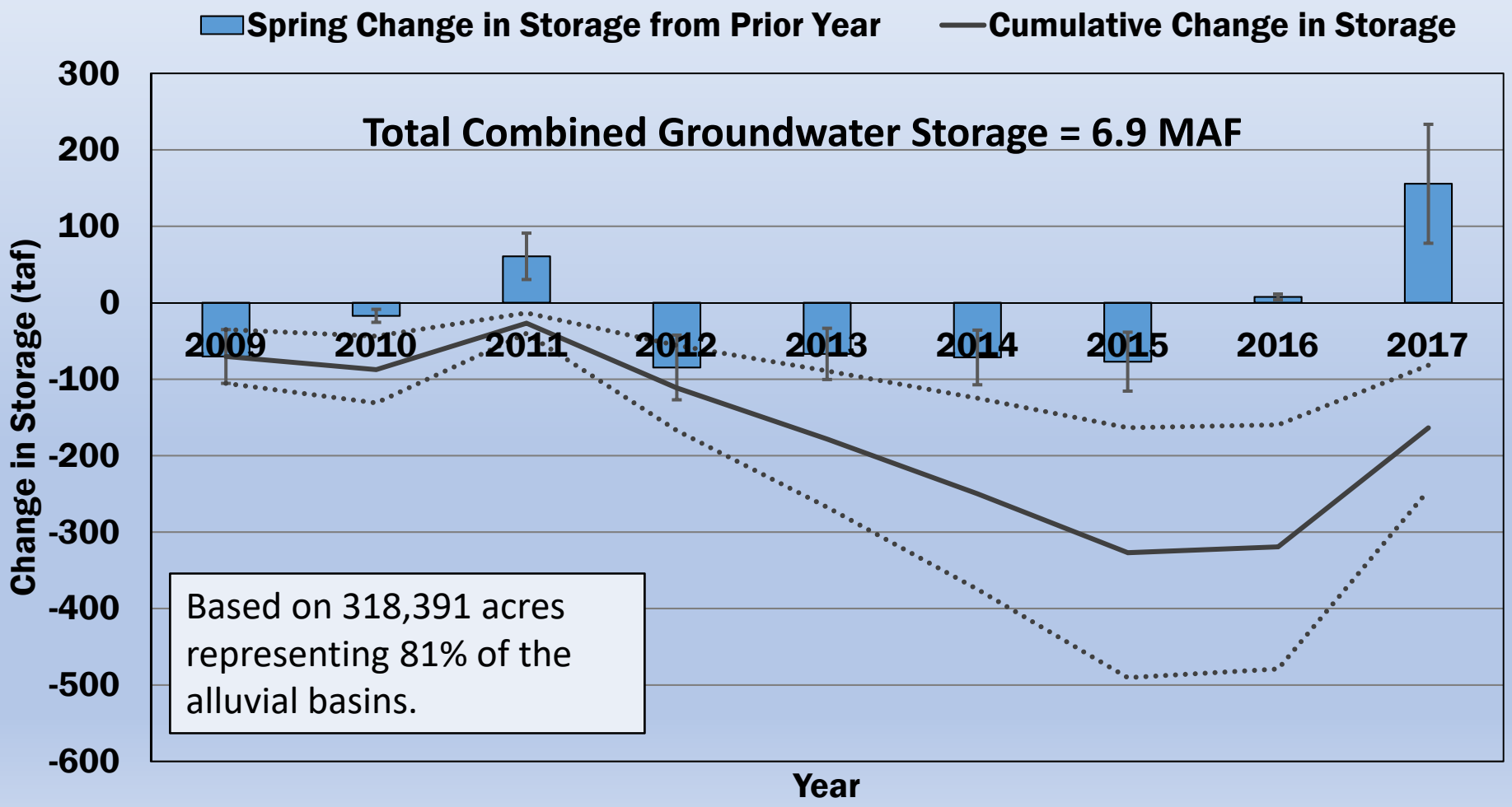
Sustainability Indicator #2: Reduction of Groundwater Storage

Subbasin Storage Capacities (DWR Bulletin 118-2003)

Subbasin	Total Area (acres)	Area within Glenn County (acres)	Percentage Area within Glenn County	Total Subbasin Storage Capacity (MAF) (Bulletin 118)	**Subbasin Storage Capacity in Glenn Co. (MAF)**
Colusa	705,170	305,388	43%	13.0	**5.6**
Corning	206,886	44,851	22%	2.8	**0.6**
West Butte	180,429	44,971	25%	2.8	**0.7**
Total	**1,092,485**	**395,210**	**36%**	**18.5**	**6.9**

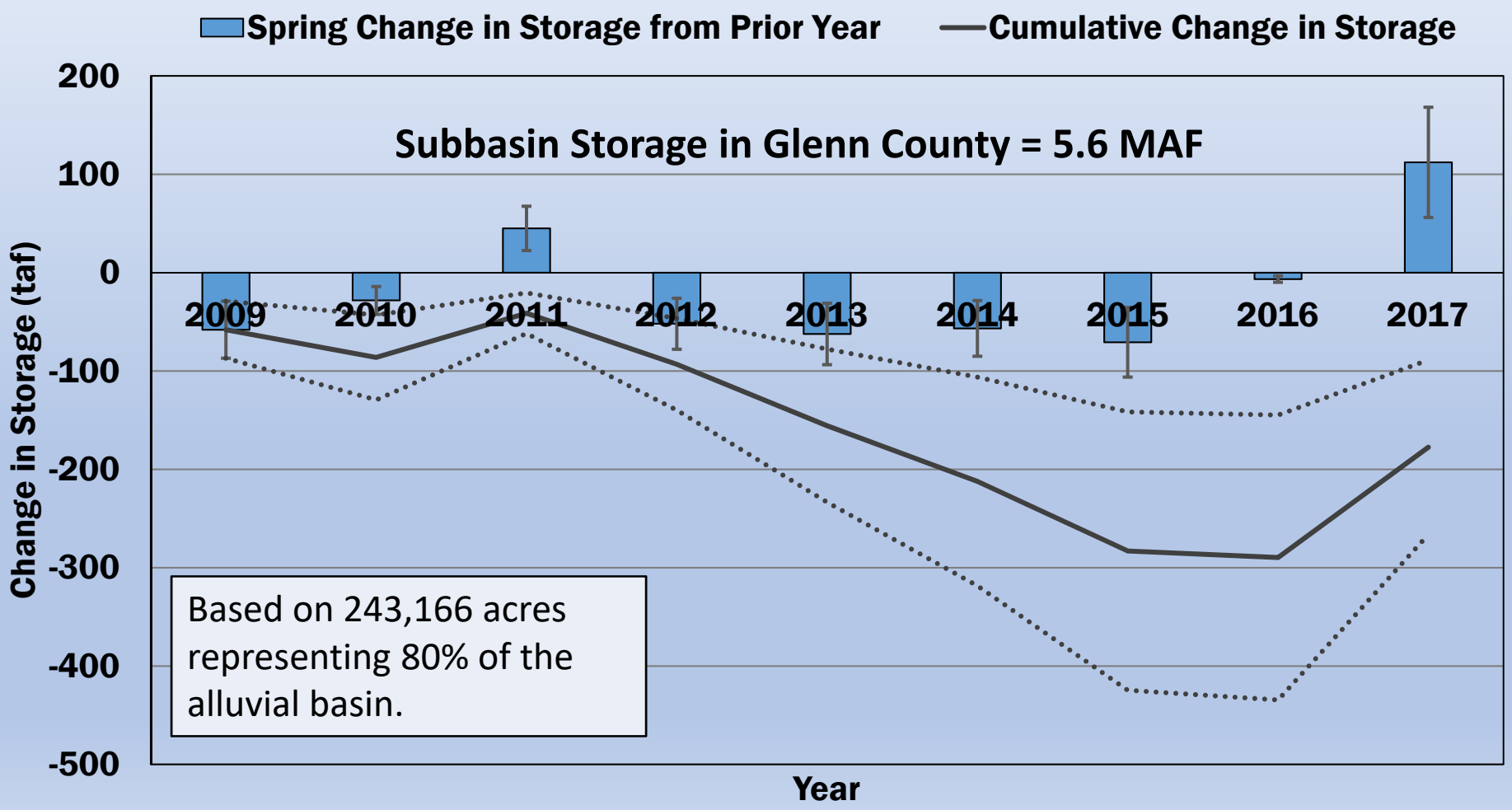
Sustainability Indicator #2: Reduction of Groundwater Storage 2009 through 2016

Portions of Colusa, Corning and West Butte Subbasins in Glenn County Combined



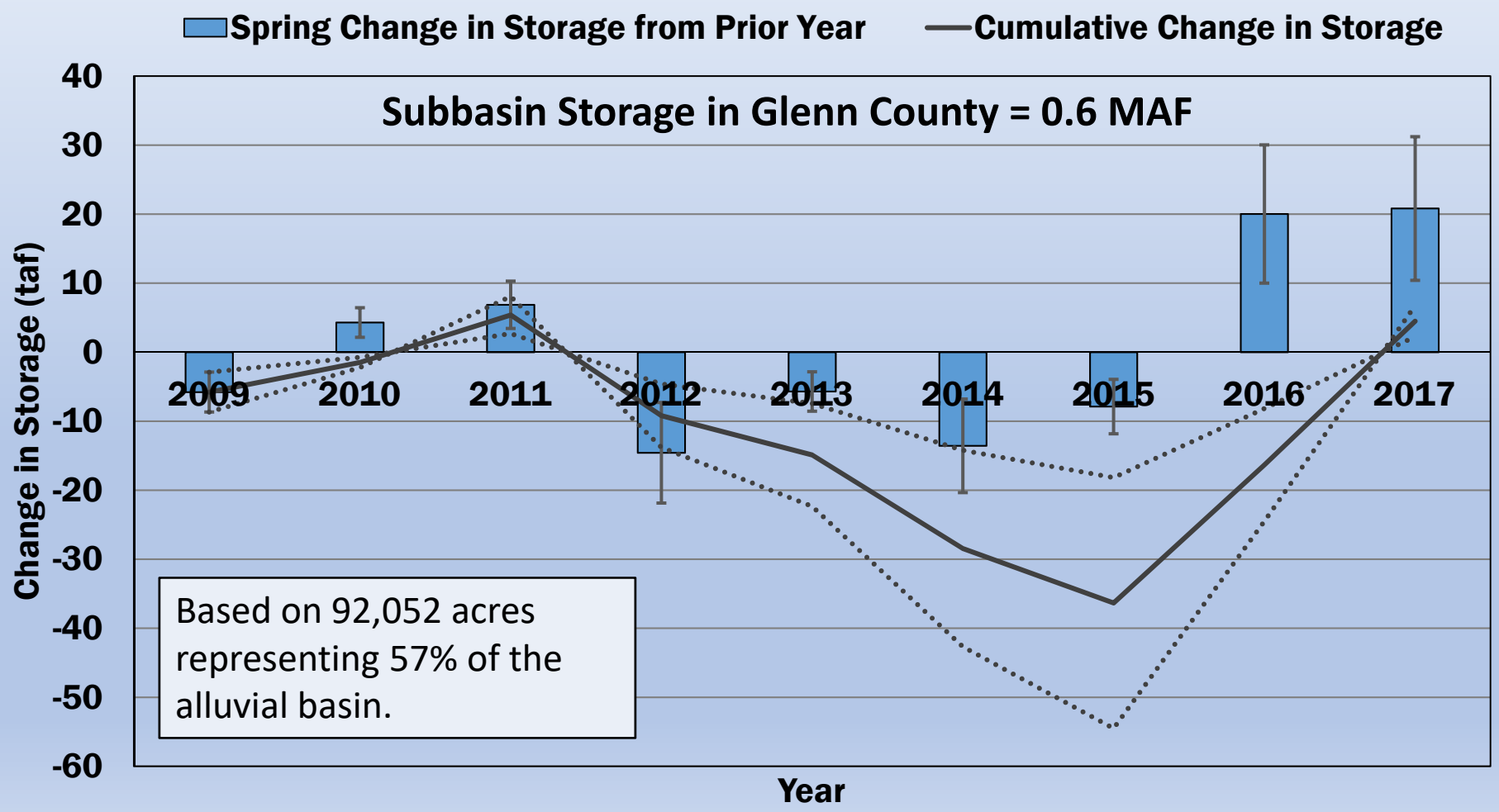
Sustainability Indicator #2: Reduction of Groundwater Storage 2009 through 2016

Portion of Colusa Subbasin in Glenn County



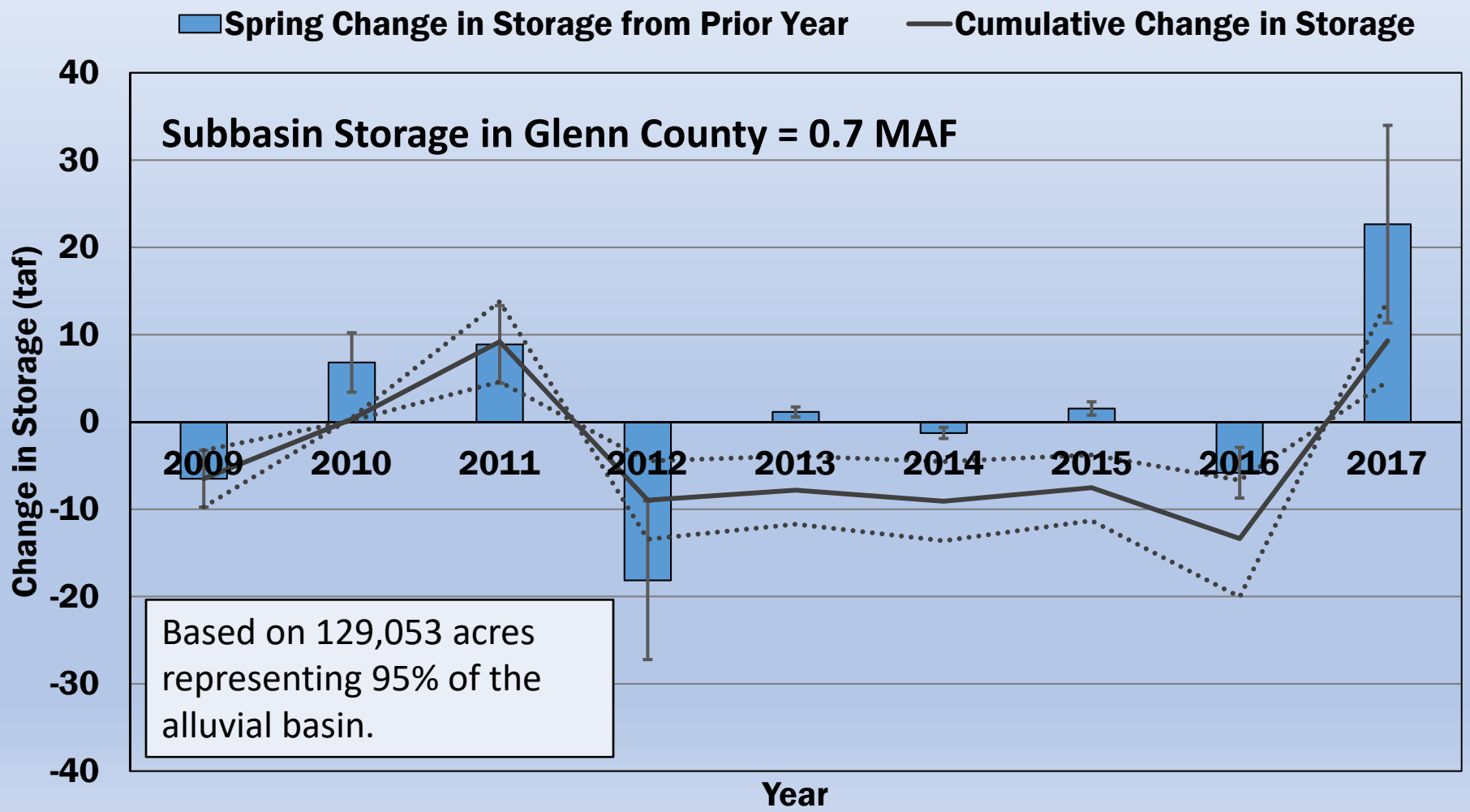
Sustainability Indicator #2: Reduction of Groundwater Storage 2009 through 2016

Portion of Corning Subbasin in Glenn County



Sustainability Indicator #2: Reduction of Groundwater Storage 2009 through 2016

Portion West Butte Subbasin in Glenn County



Sustainability Indicator #2: Reduction of Groundwater Storage

Conclusions:

- Recent reductions in groundwater storage (during the past 8 years) are modest relative to the total volume of groundwater in storage (~1% to 4%) and other areas of the state
- Other sustainability indicators will likely pose sustainability challenges before reduction of groundwater storage
- May need to address storage reduction directly in some areas

Sustainability Indicator #3: Seawater Intrusion

- Physically impossible; therefore, exempt

Sustainability Indicator #4: Degraded Water Quality

- Minimum Threshold: "…degradation of water quality…that may lead to undesirable results." § 354.28 (c) (4)
- Potential Undesirable Results:
  - Unsuitable quality for beneficial uses
    - Agriculture
    - Drinking water
    - Stock water
    - Environmental uses
  - Reduced crop yields
  - Increased water treatment costs
  - Inability/cost to comply with regulatory standards
    - Drinking water regulations
    - Basin Water Quality Control Plan

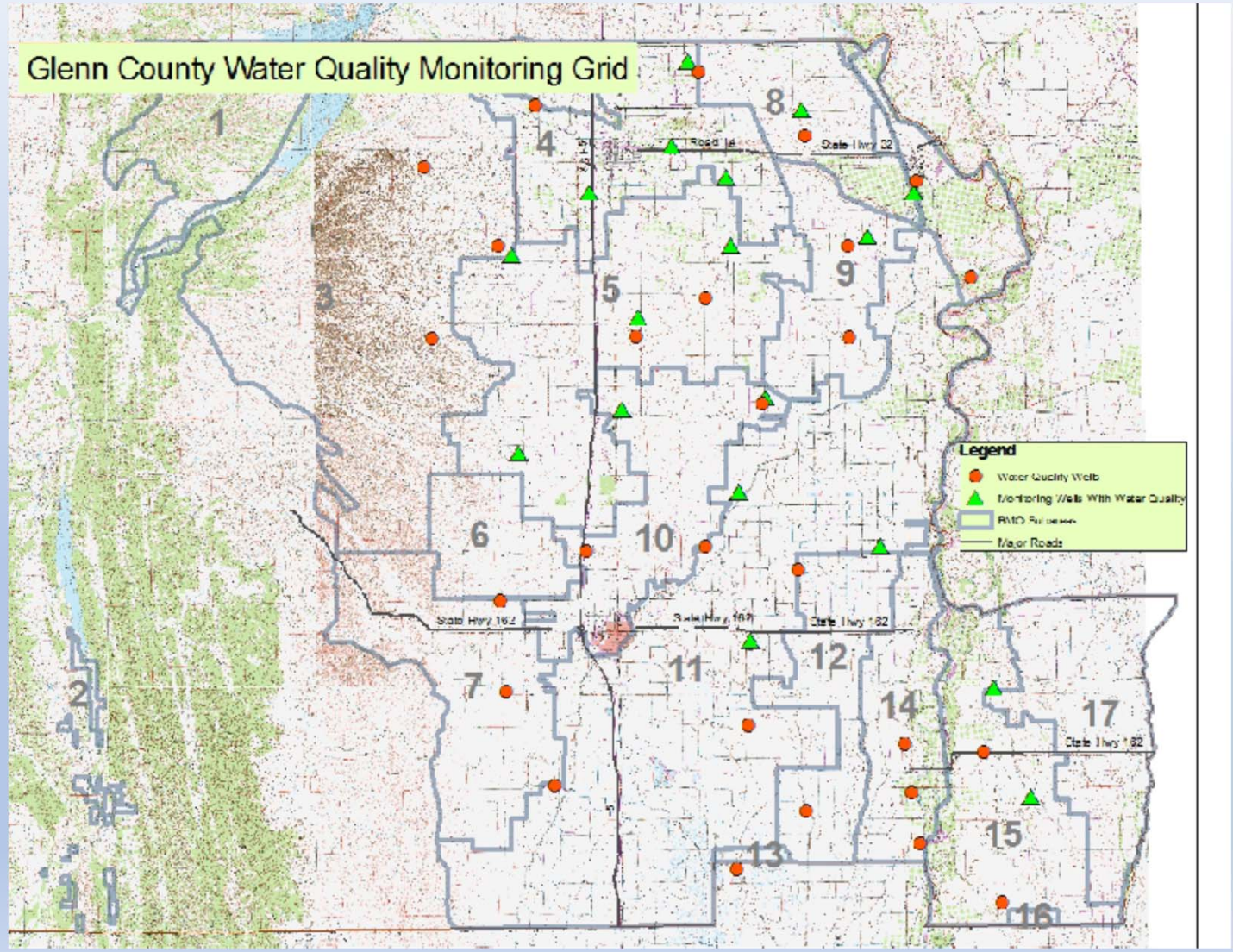
Sustainability Indicator #4: Degraded Water Quality

- Glenn County Groundwater Quality Monitoring Program
  - Separate set of 29 DWR monitoring wells than those used for water levels, organized by BMO area
  - Temperature, pH and salinity (measured as total dissolved solids) main parameters sampled
  - Goal is one sample per year per well, but coverage is inconsistent in some years
- Other Sources
  - Sacramento Valley Water Quality Coalition Comprehensive Groundwater Quality Assessment Report (NCWA 2014)
  - Sacramento Valley Water Quality Coalition Comprehensive Groundwater Quality Management Plan (NCWA 2017)
- Does not address monitoring of contaminant plumes

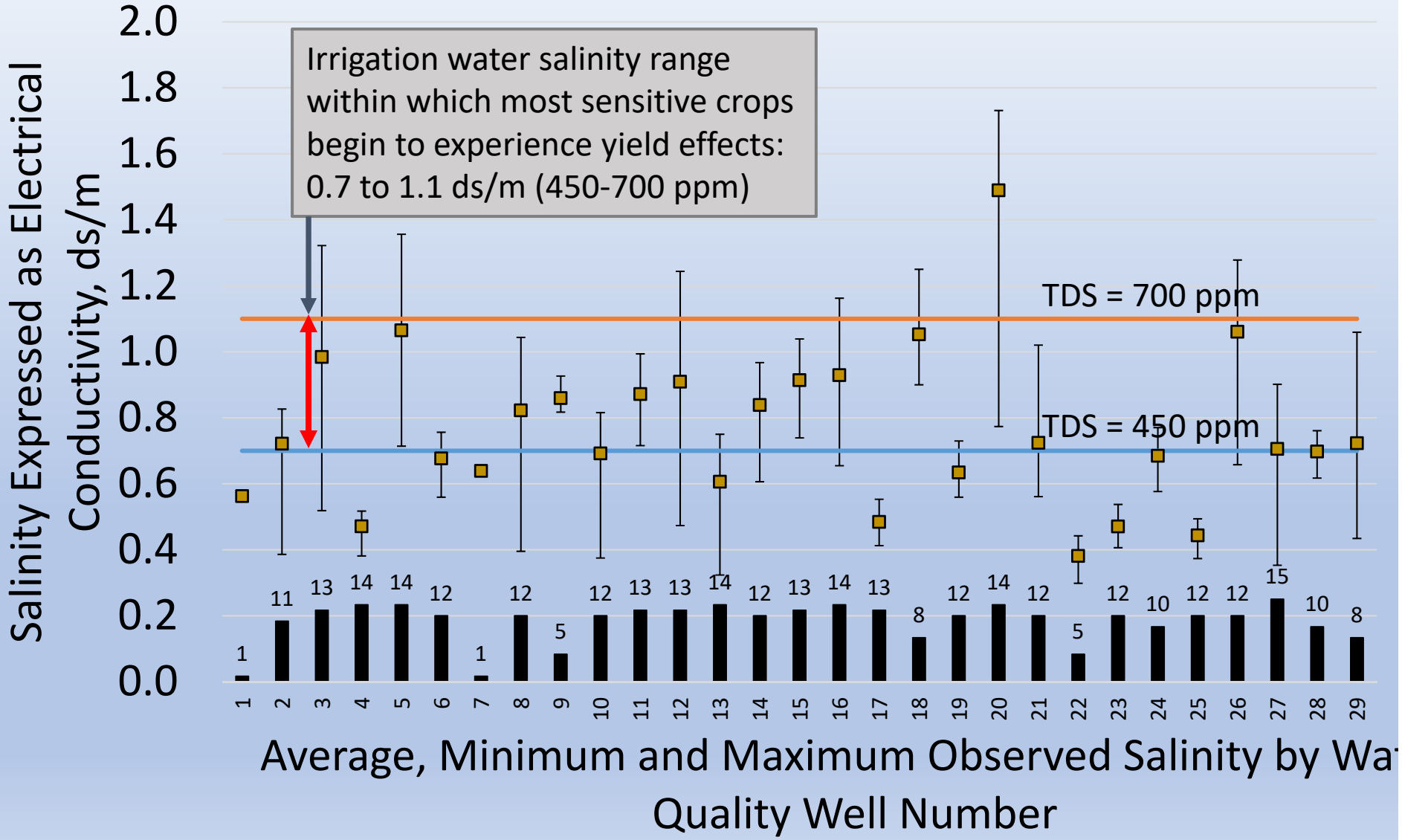
Sustainability Indicator #4: Degraded Water Quality

- Groundwater Quality
  - Generally excellent
  - Some areas of concern for nitrate (Willows and south of Orland)
  - Potential Data Gaps in Northwestern Portion of County
- Groundwater Vulnerability
  - Intrinsic factors
    - Soils and hydrogeology
    - Naturally occurring contaminants (arsenic, boron, etc.)
    - Geochemical characteristics (salinity, alkalinity, etc.)
  - Anthropogenic (human) factors
    - Cropping, irrigation, nutrient, and pesticide management practices
    - Dairies and feedlots
    - Wastewater treatment and disposal practices
    - Domestic and municipal well construction

Sustainability Indicator #4: Degraded Water Quality

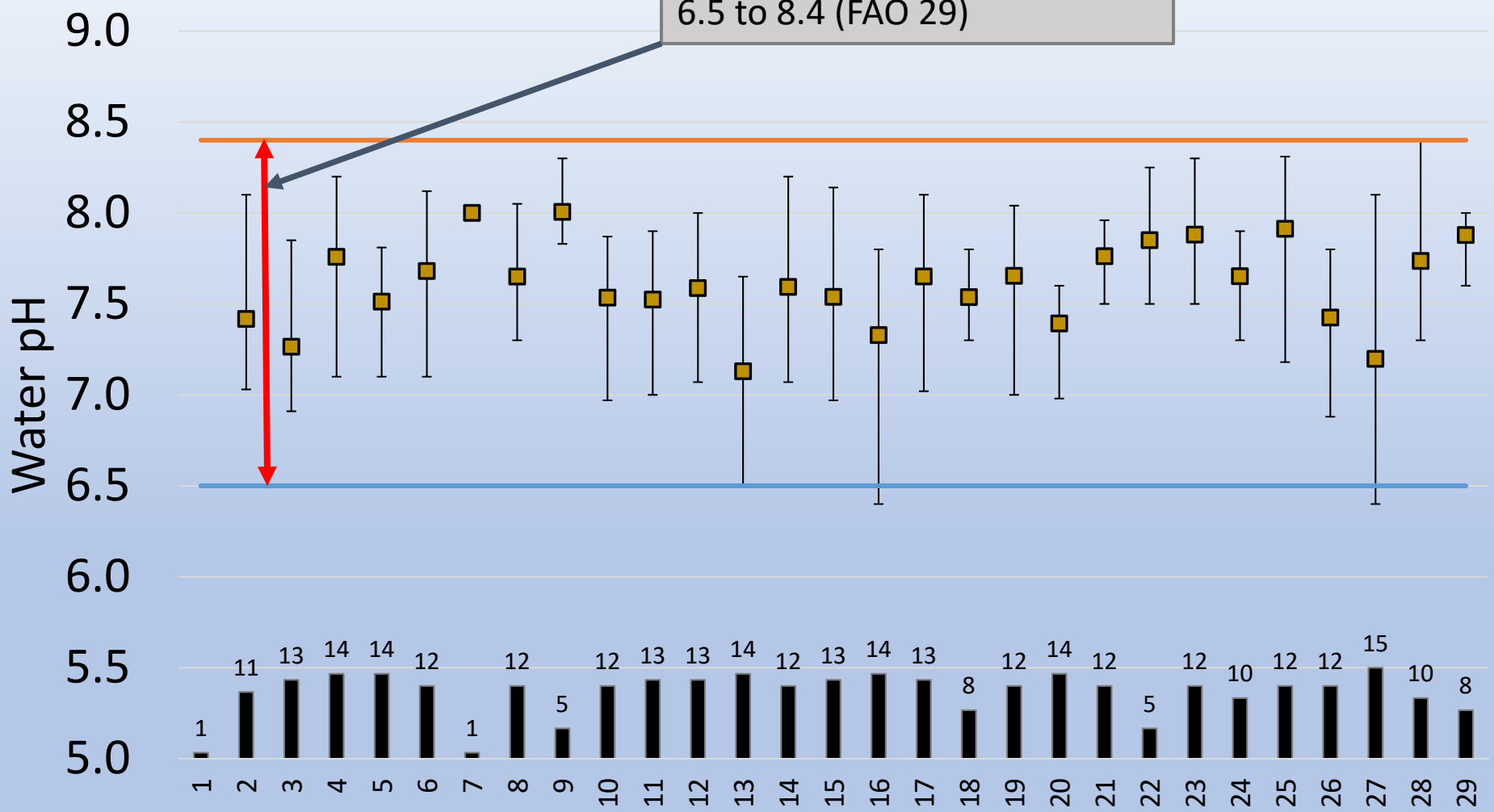


Groundwater Salinity (dS/m)



Groundwater pH

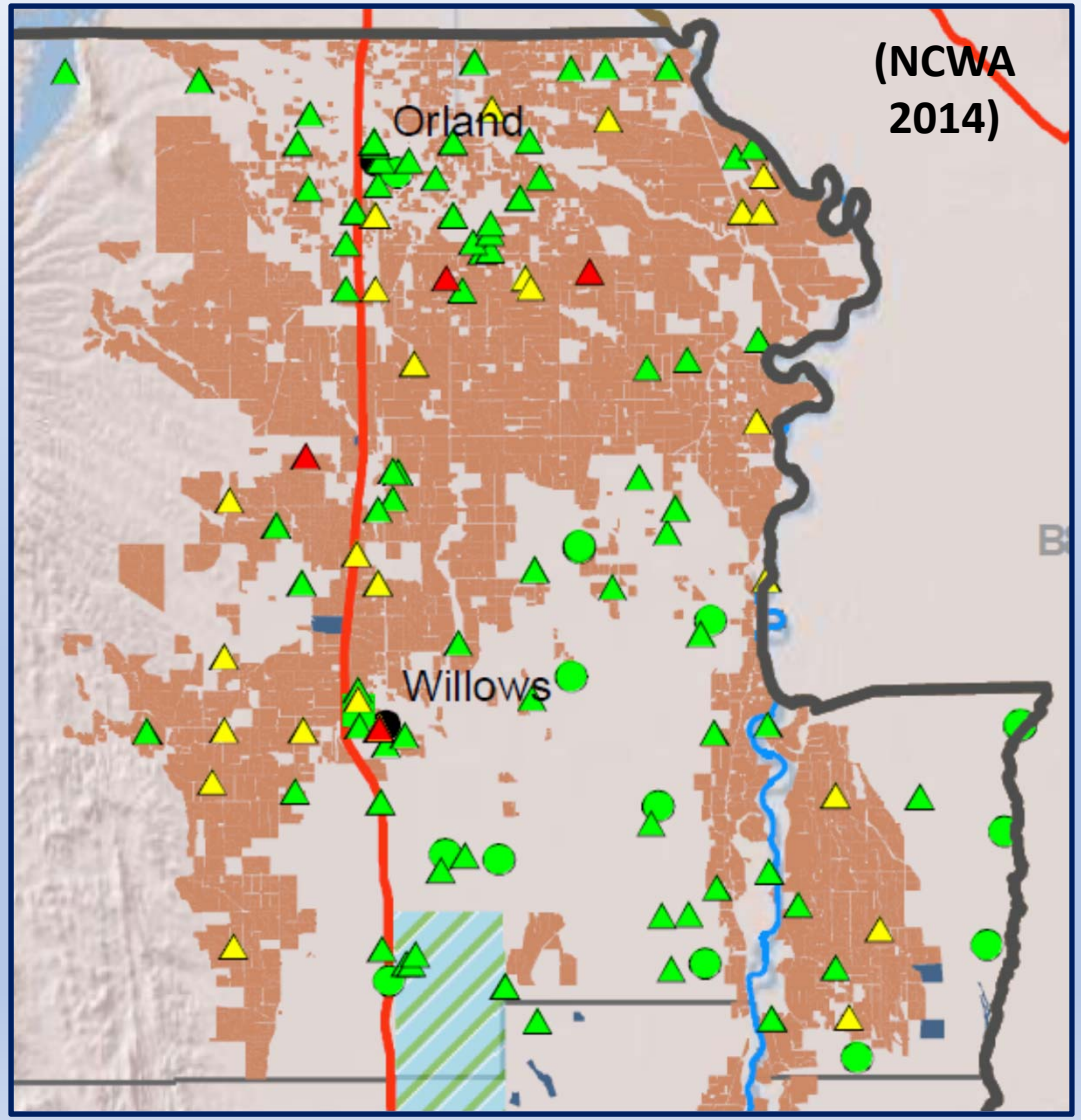
pH range generally considered suitable for irrigation water: 6.5 to 8.4 (FAO 29)



Average, Minimum and Maximum Observed pH by Water Quality Well Number

Sustainability Indicator #4: Degraded Water Quality

- Elevated nitrate in Willows and south of Orland
- Generally below drinking water standards
- May originate from wastewater treatment systems and dairy operations

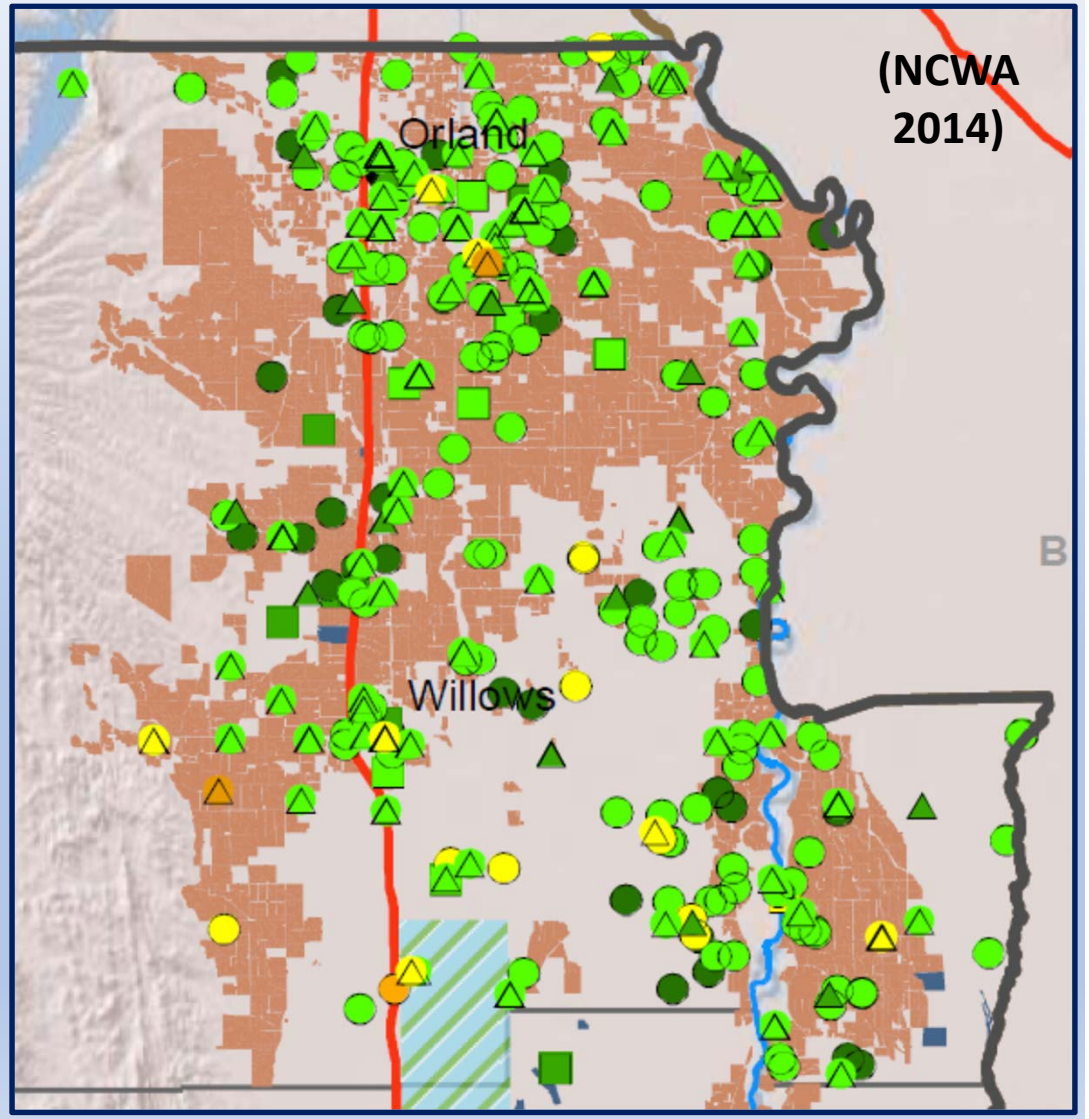


NO3 Concentration(mg/L)

- < 22.5
- 22.5 - 45
- > 45

Sustainability Indicator #4: Degraded Water Quality

- Low to moderate salinity throughout County
- Potential for elevated salinity along Coast Range foothills

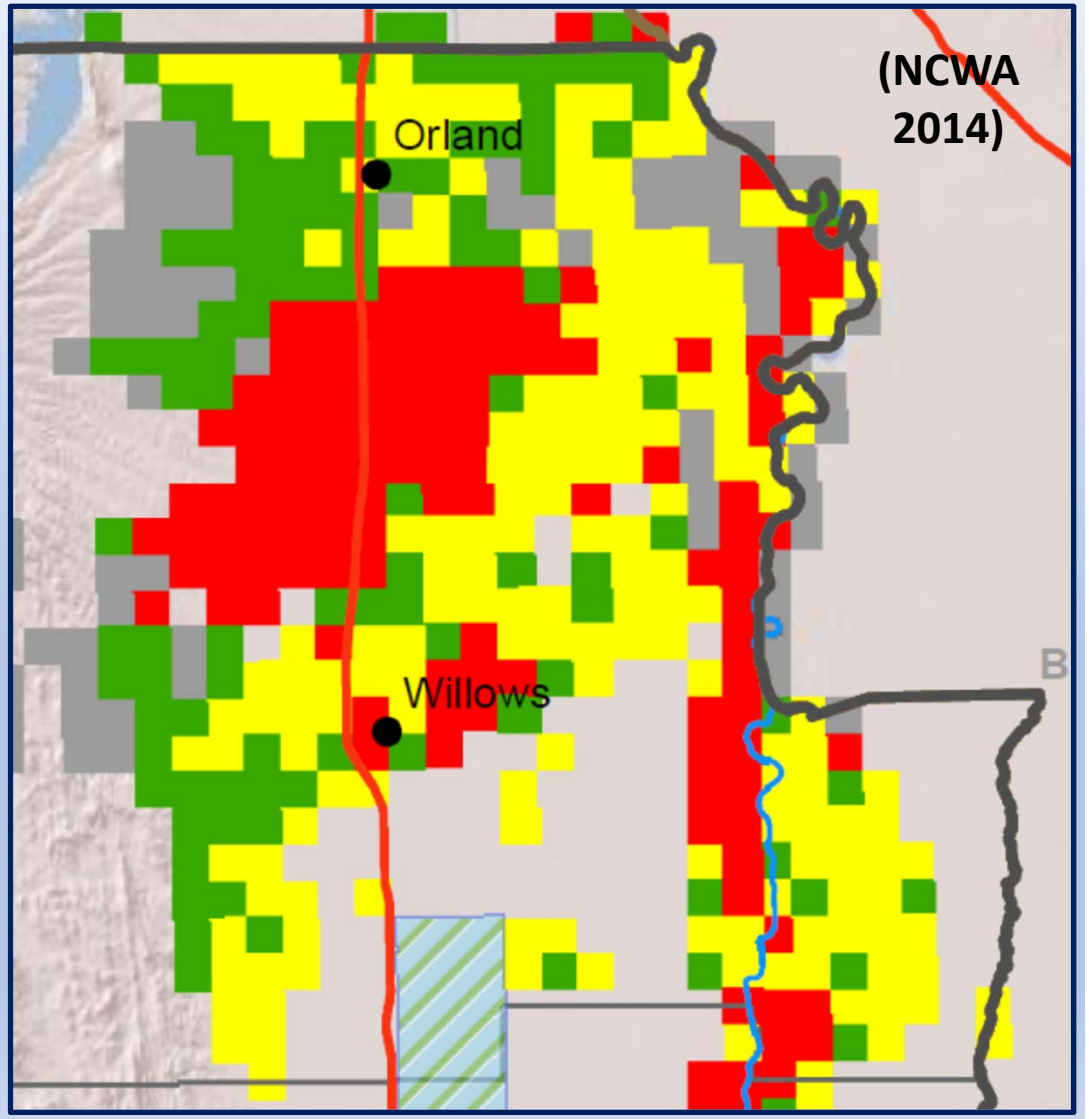


TDS Concentration(mg/L)

- < 250
- 251 - 500
- 501 - 1000
- 1001 - 1500
- > 1500

Sustainability Indicator #4: Degraded Water Quality

- NCWA assessment suggests vulnerability between Orland and Willows and along Sacramento River
- Areas of greater vulnerability generally related to irrigation method and soil texture



Vulnerability

- High
- Moderate
- Low
- data gap or outside SVGB boundary

Observations from Available Water Quality Data

- Groundwater quality generally excellent for agricultural purposes
- Some areas of elevated nitrate and relatively high vulnerability
- Monitoring will include more constituents and be conducted more consistently
- Monitoring should be designed to detect potential upwelling of saline groundwater
- Efforts underway to conduct trend monitoring through Sacramento Valley Groundwater Regional Monitoring Plan

Sustainability Indicator #4: Degraded Water Quality

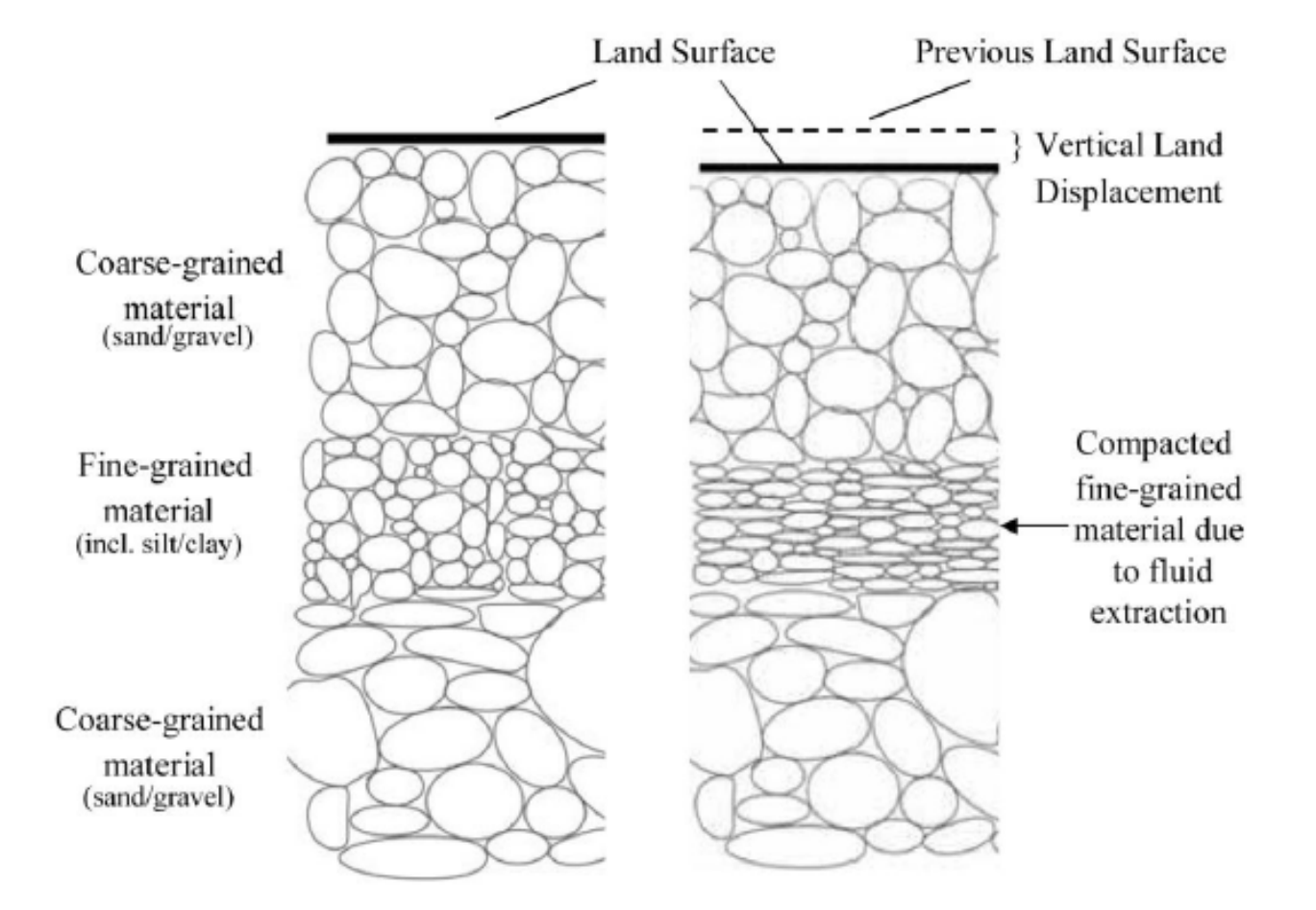
Conclusions:

- Subject to ongoing monitoring, unlikely that water quality degradation will pose sustainability challenges or subbasin operational limitations
- Existing efforts by Glenn County and Sacramento Valley Groundwater Quality Coalition provide a great starting point to address SGMA requirements
- Drinking water quality and contaminant plumes, if identified, will need to be addressed separately

Sustainability Indicator #5: Land Subsidence

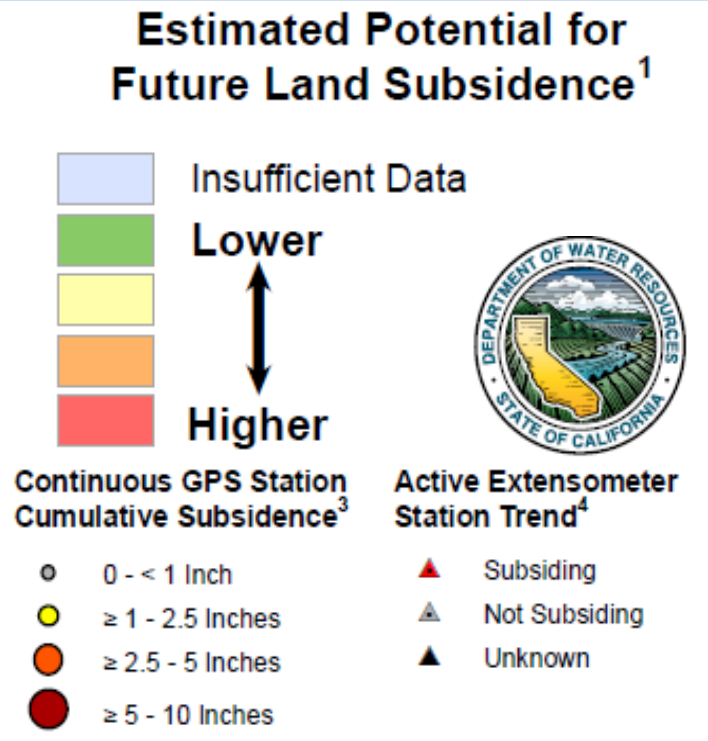
- Minimum Threshold: "…the rate and extent of subsidence that substantially interferes with land surface uses and may lead to undesirable results." § 354.28 (c) (5)
- Potential Undesirable Results:
  - Permanent loss of aquifer storage capacity
  - Damage to foundations, roads, bridges, other infrastructure
  - Change in surface topography that reduces conveyance capacities of canals, natural channels, floodplains
  - Other effects

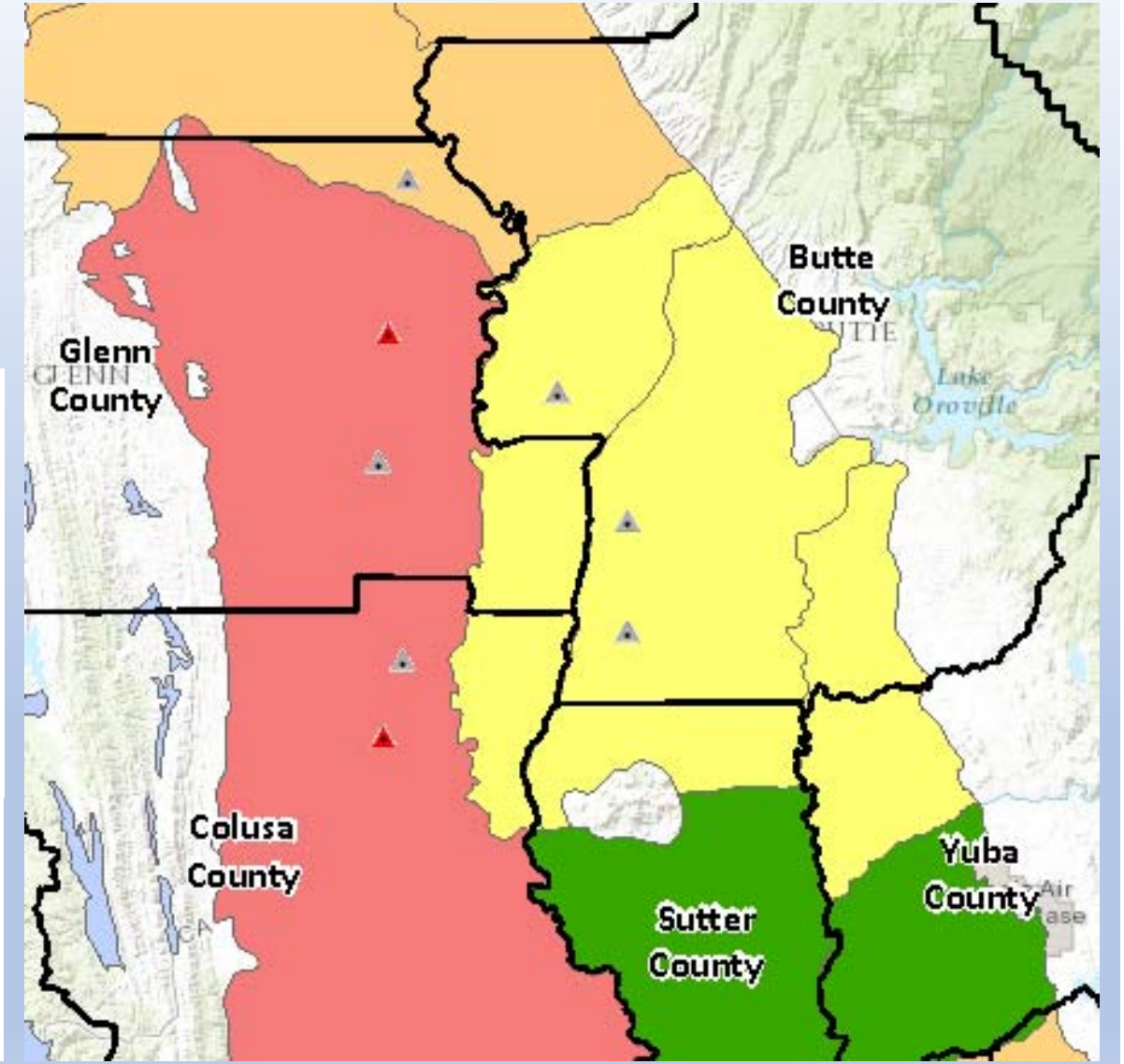
Sustainability Indicator #5: Land Subsidence



Source: Land Subsidence from Groundwater Use in California, Luhdorff & Scalmanini Consulting Engineers

Sustainability Indicator #5: Land Subsidence

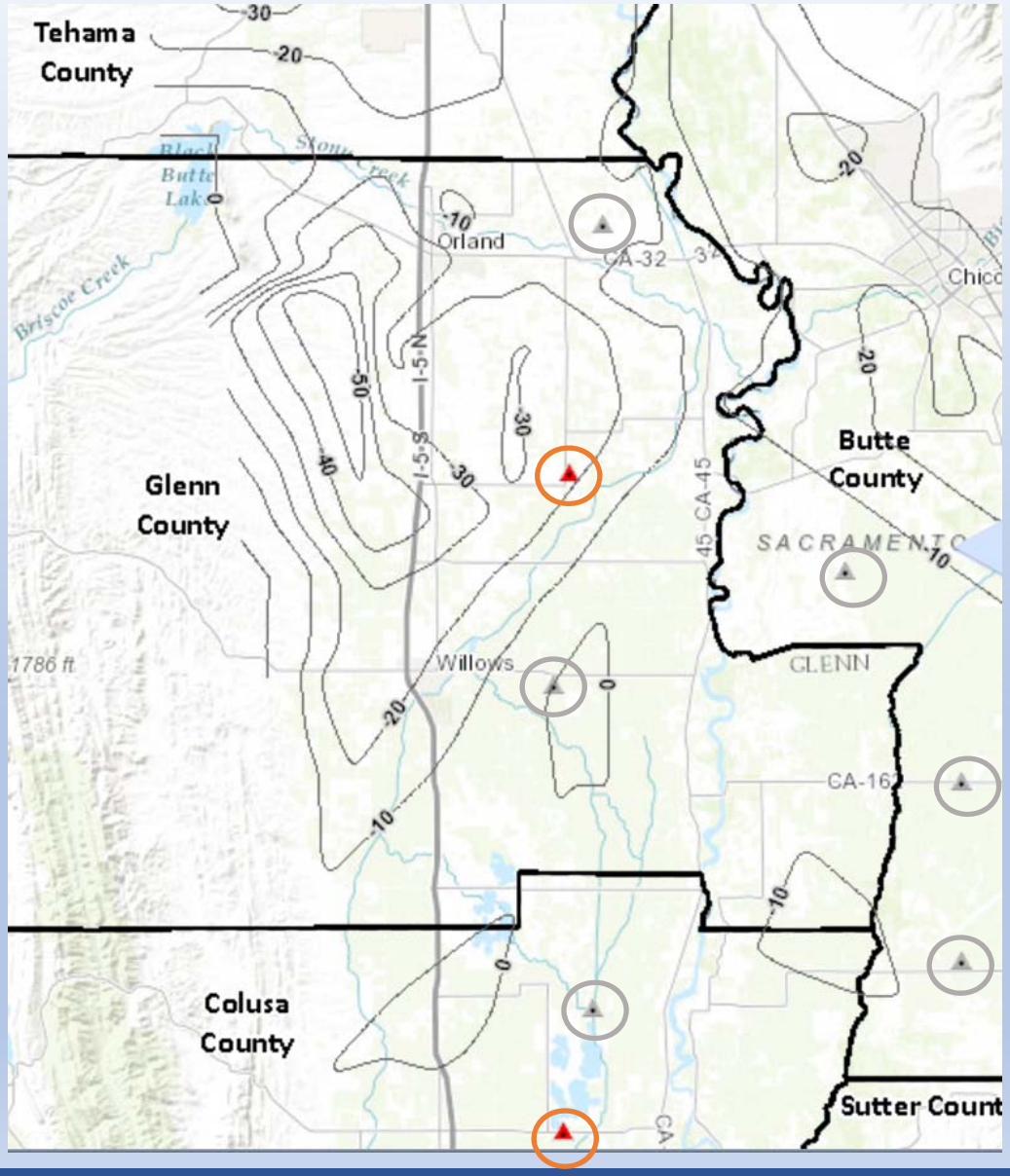




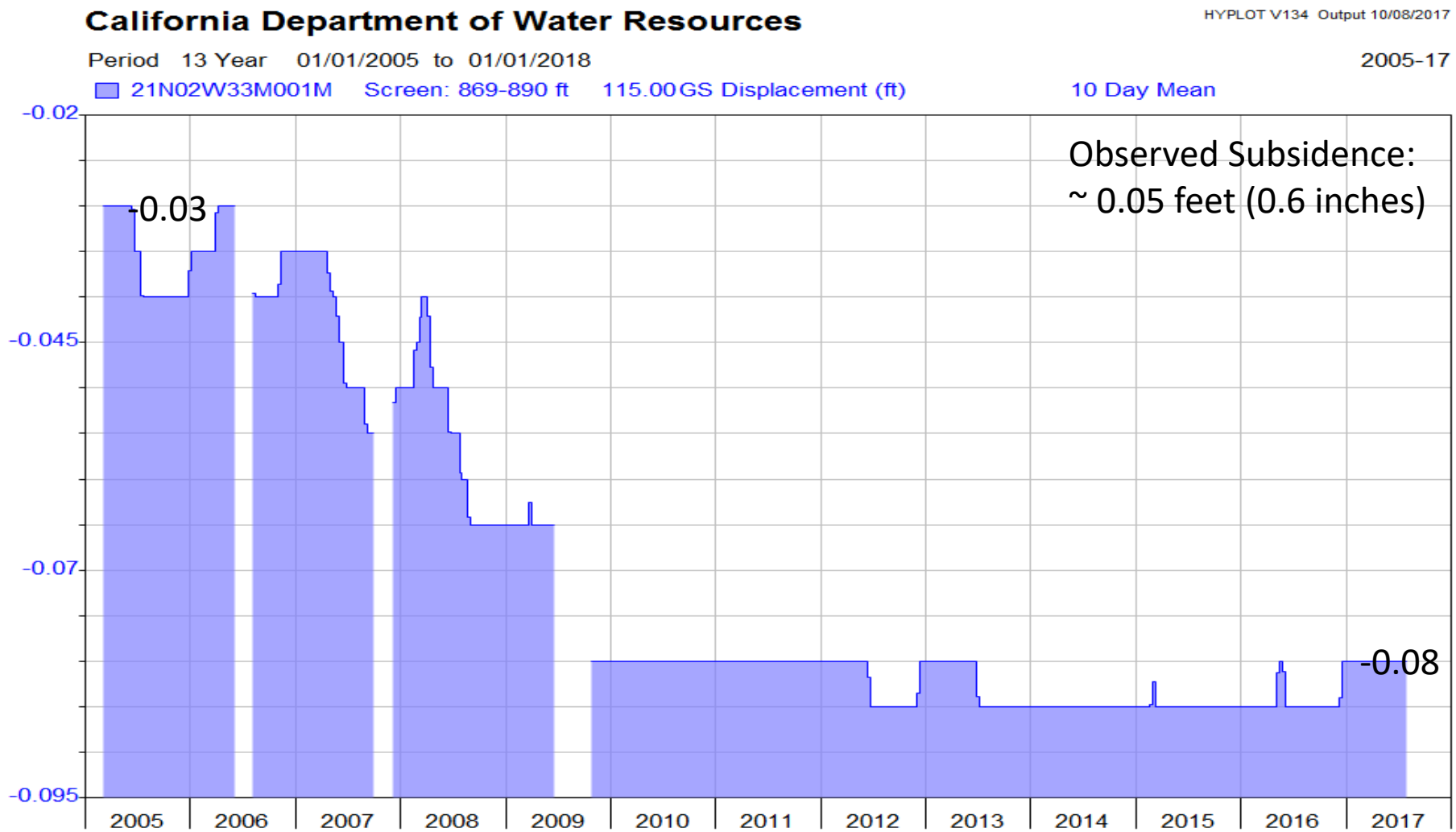
Sustainability Indicator #5: Land Subsidence

Extensometer—with subsidence

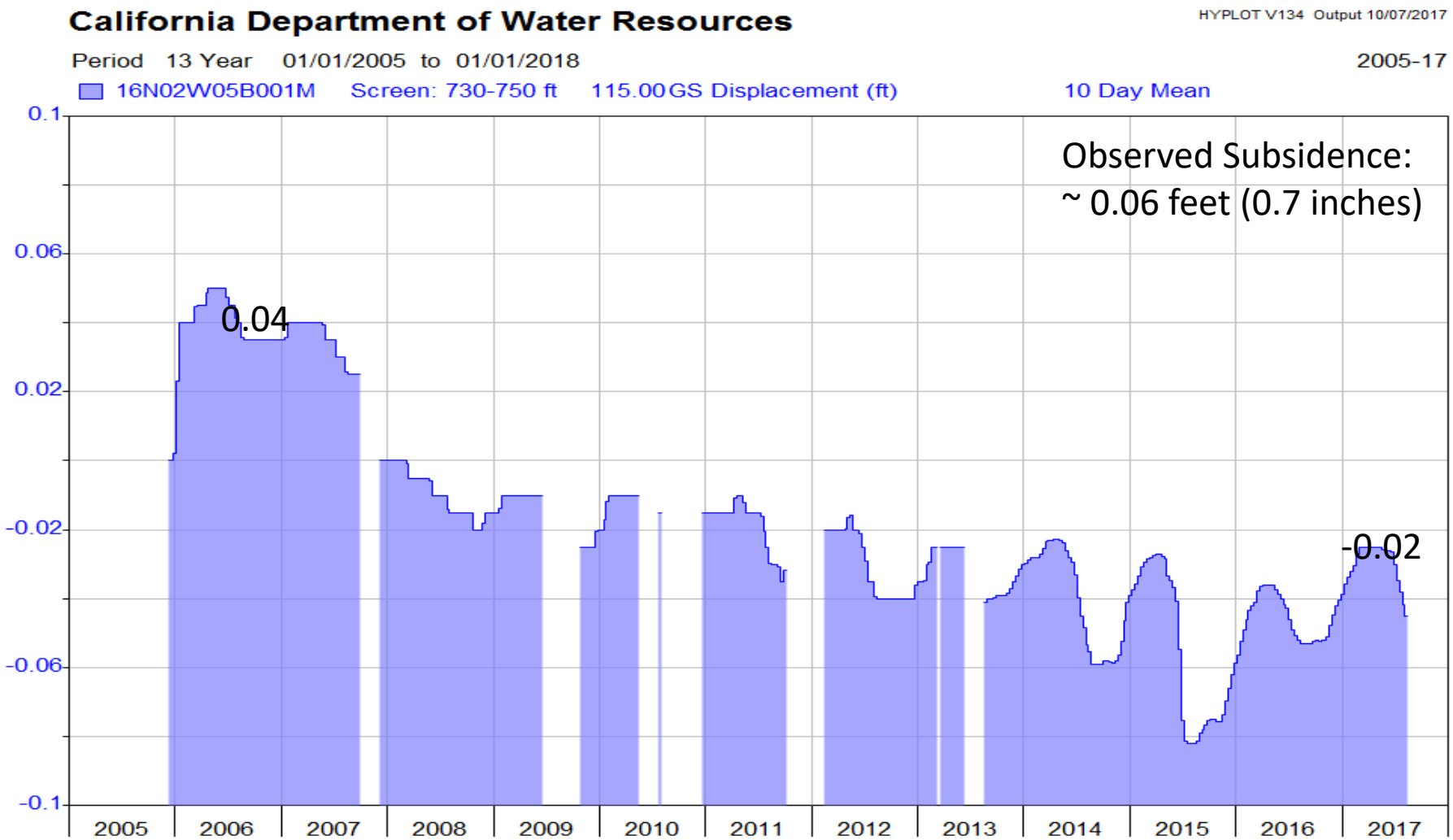
Extensometer—no subsidence



Sustainability Indicator #5: Land Subsidence (Glenn County Extensometer)



Sustainability Indicator #5: Land Subsidence (Colusa County Extensometer)



Sustainability Indicator #5: Land Subsidence

Conclusions:

- Minor detectable land subsidence in the County based on extensometer data
  - Will know more when new GPS survey results are published in 2018
- Land subsidence will definitely need to be addressed in GSP, with emphasis on monitoring

Sustainability Indicator #6
Depletions of Interconnected Surface Water

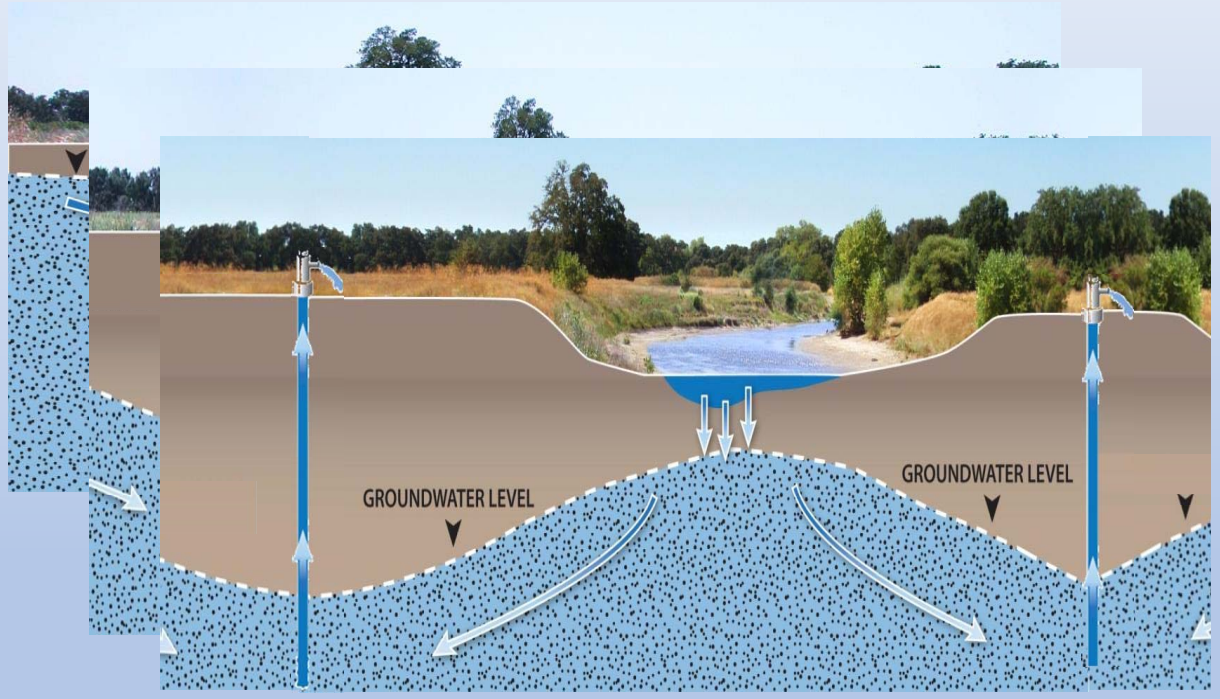
- Minimum Threshold: "…the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of surface water and may lead to undesirable results."
- Potential Undesirable Results:
  - Reduced water availability to legal users of surface water
  - Reduced water availability to "Groundwater Dependent Ecosystems" (GDEs)

Sustainability Indicator #6
Depletions of Interconnected Surface Water

- Effects of pumping on both Groundwater Dependent Ecosystems (GDEs) and streamflow depletion potentially significant but conclusive data are lacking
- DWR developing new analytic tool specifically to address surface water-groundwater interaction
  - SVSim Model (initial release expected early 2018)
  - Best Management Practices (BMPs) for local agencies to consider adopting for monitoring and analyzing effects of declining groundwater elevations
- The Nature Conservancy leading statewide effort to develop GDE guidelines for local agencies

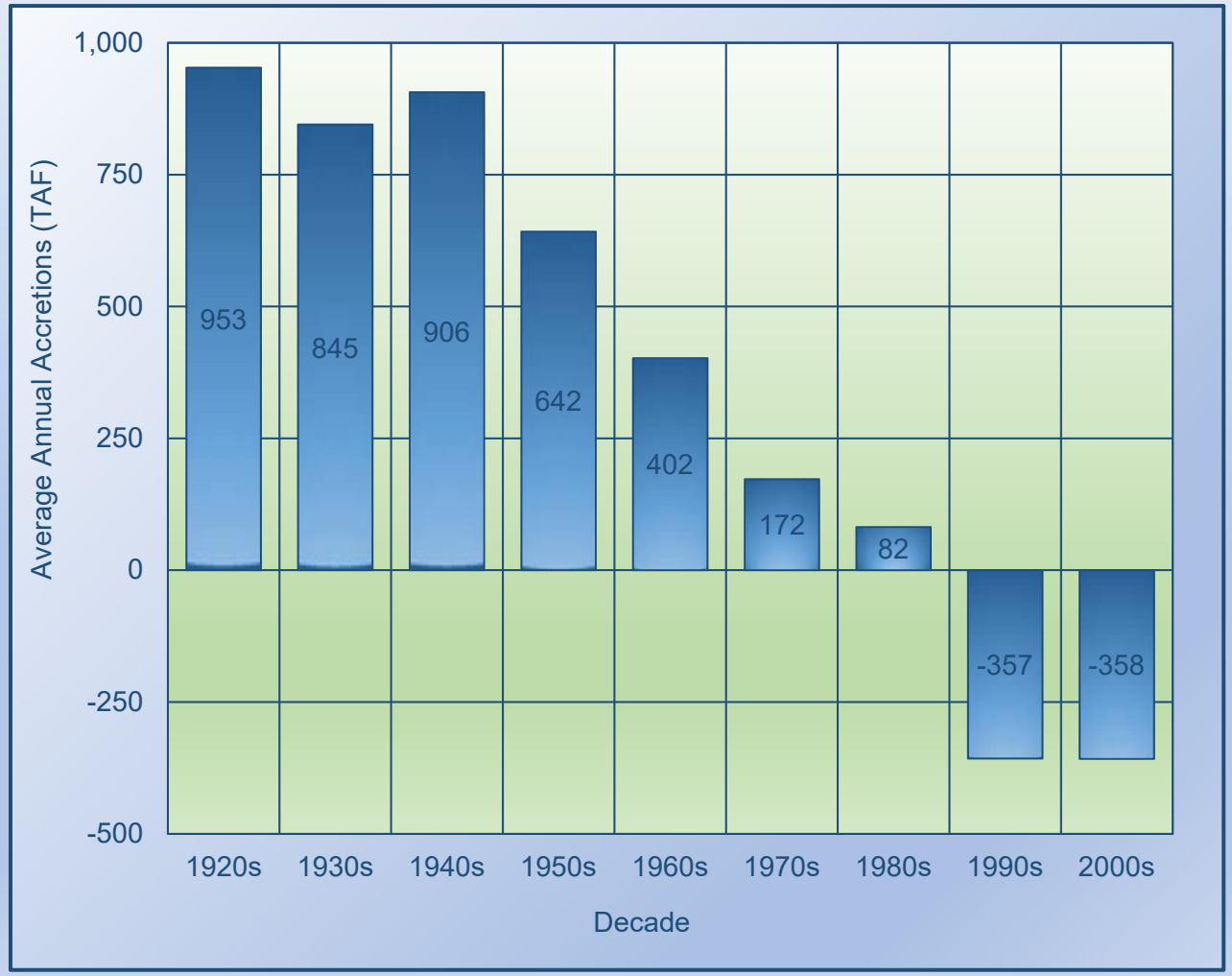
Sustainability Indicator #6
Depletions of Interconnected Surface Water

- Interaction depends on relative groundwater levels and properties of streambed and aquifer
- The uppermost groundwater sustains Groundwater Dependent Ecosystems, and river and stream flows



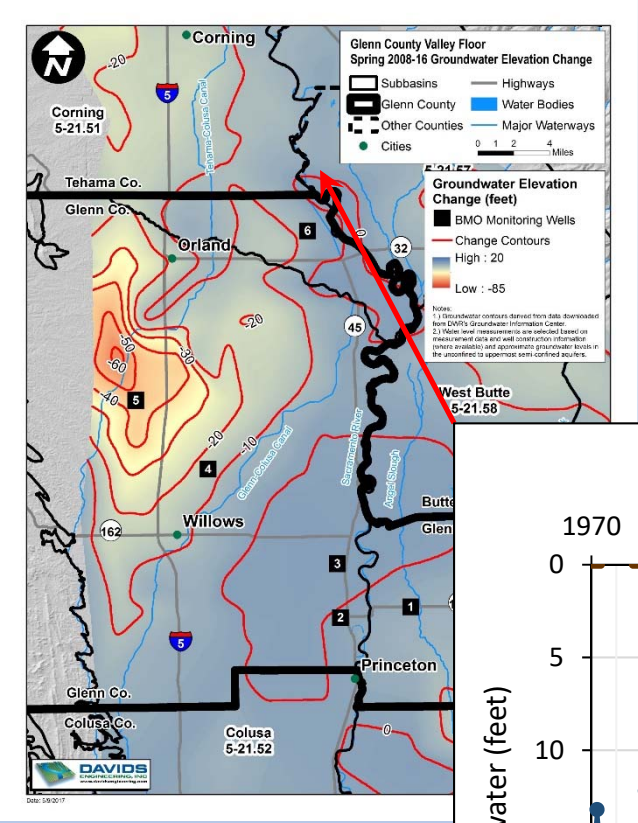
Source: The Nature Conservancy

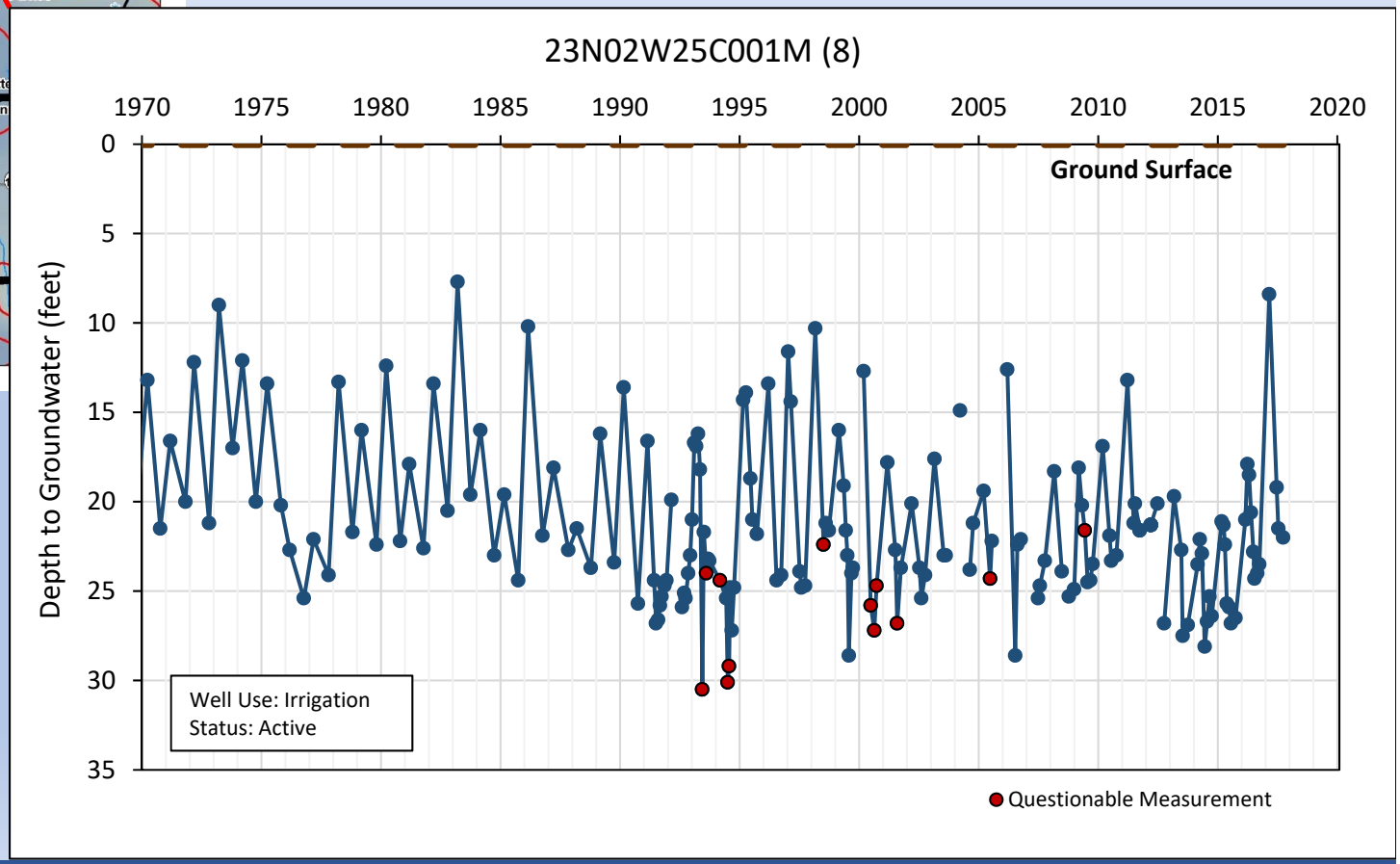
Sustainability Indicator #6
Depletions of Interconnected Surface Water



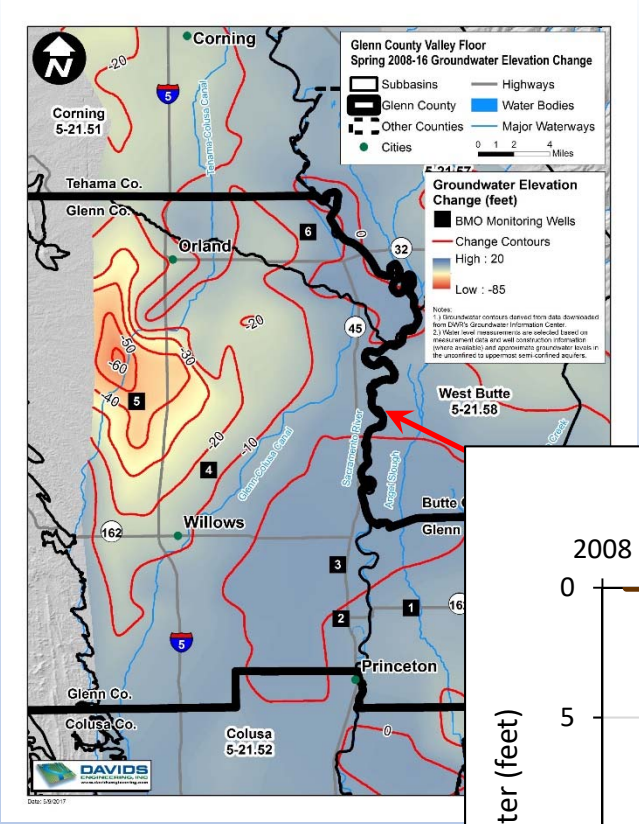
According to DWR's existing C2VSim model, Sacramento Valley streams have gone from net "gainers" to net "losers" over recent decades.

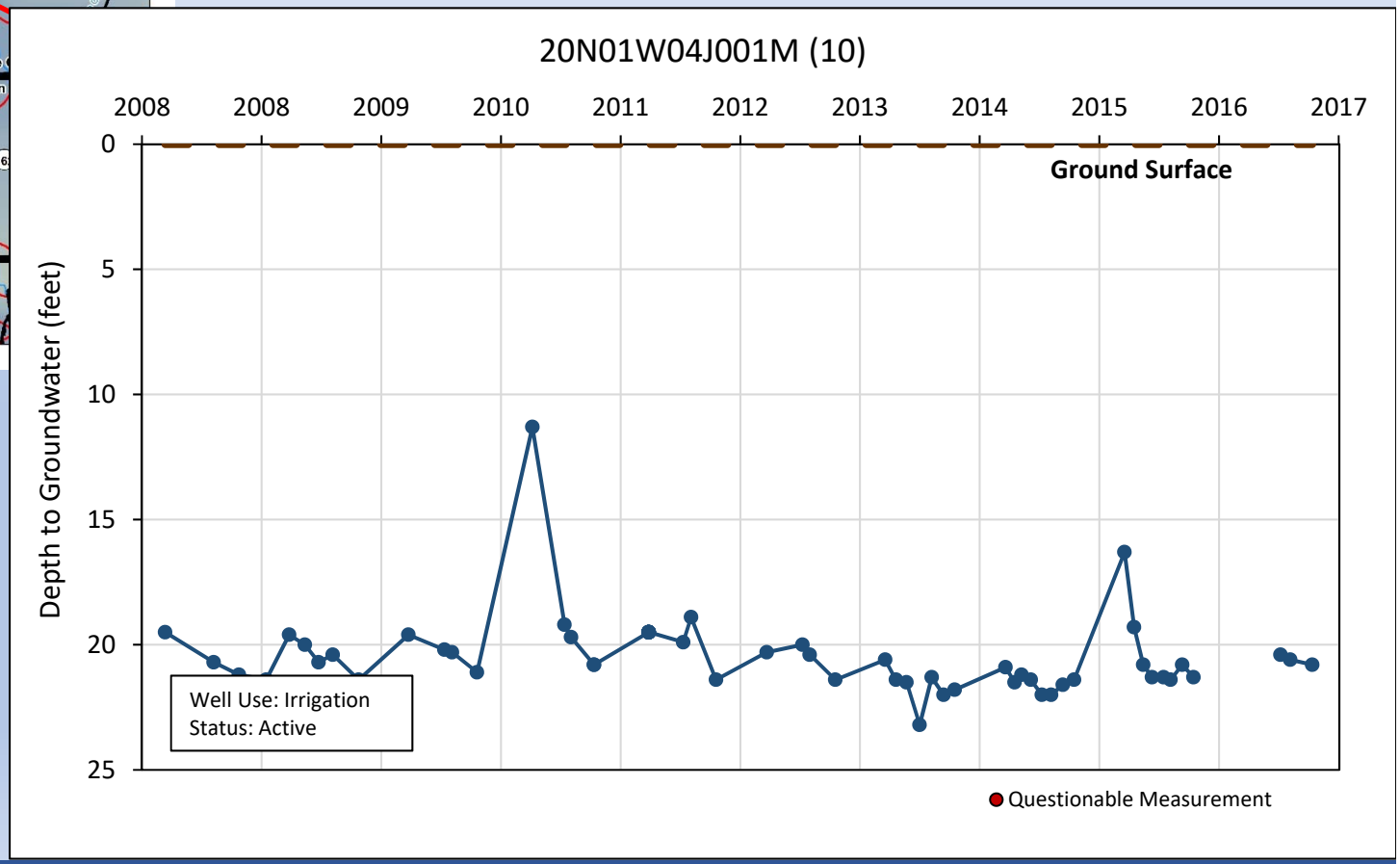
Sustainability Indicator #6 Depletions of Interconnected Surface Water: Sacramento River



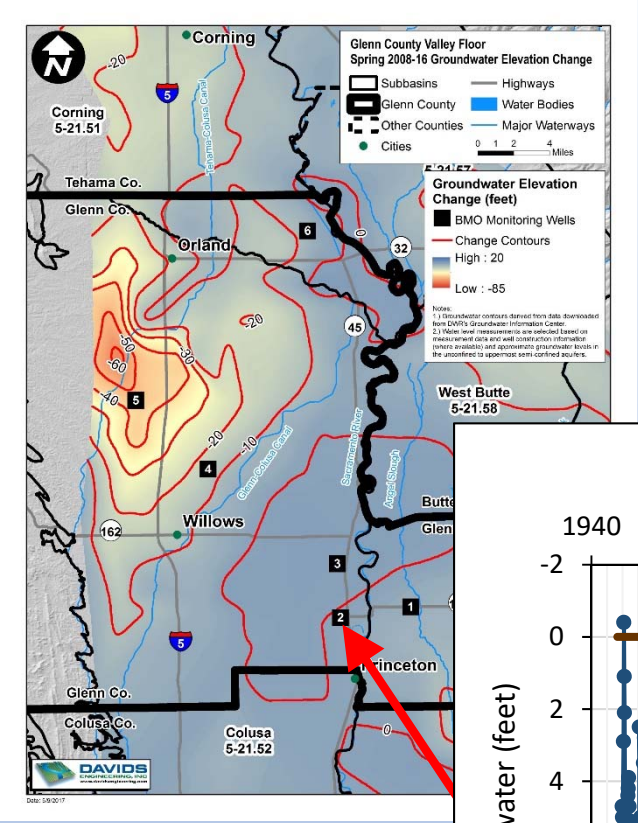


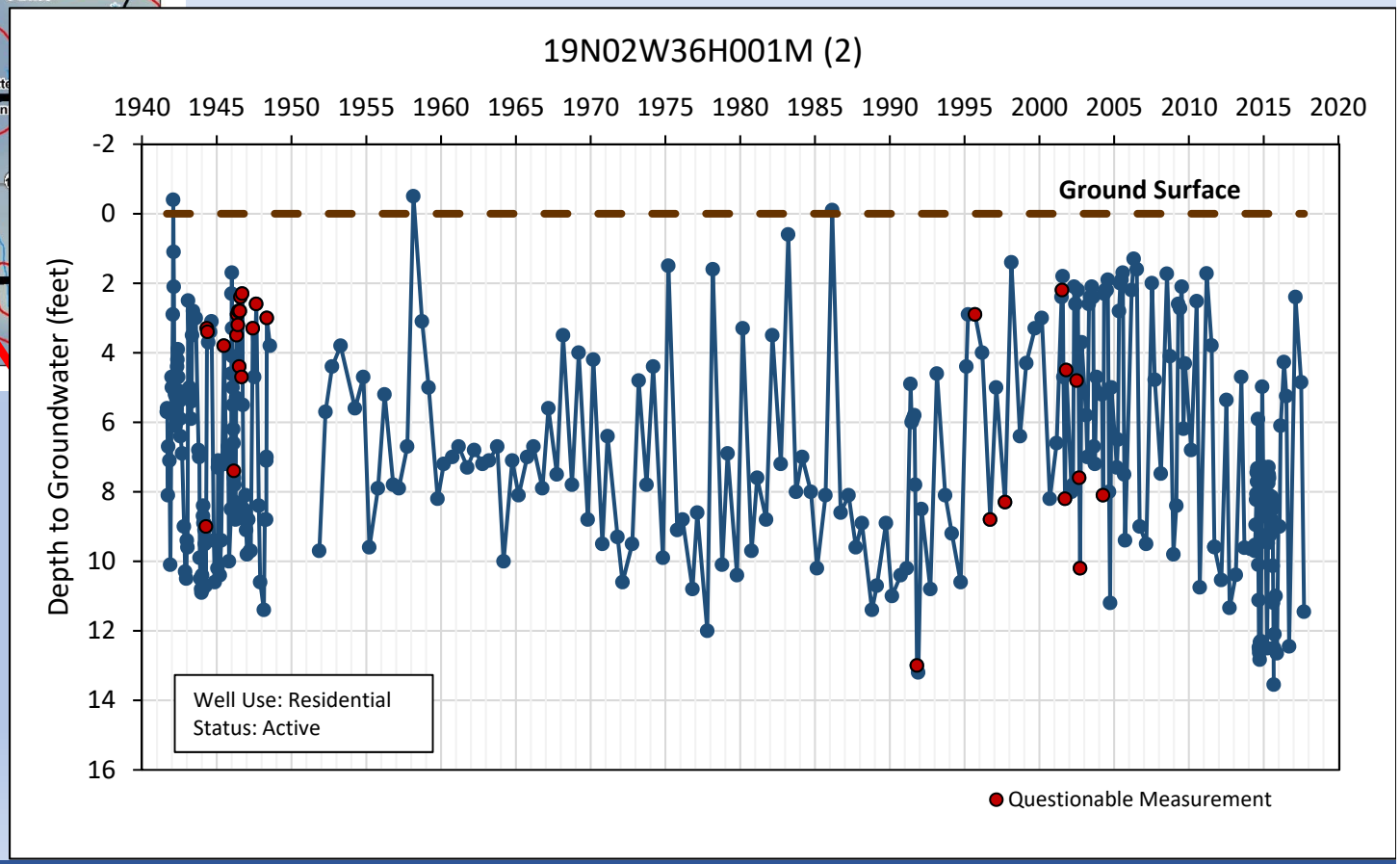
Sustainability Indicator #6 Depletions of Interconnected Surface Water: Sacramento River





Sustainability Indicator #6 Depletions of Interconnected Surface Water: Sacramento River





Sustainability Indicator #6
Depletions of Interconnected Surface Water

Conclusions:

- Will definitely need to be addressed in GSP with emphasis on monitoring to fill data gaps and analysis to characterize connections
- New tools from DWR will hopefully help better understand stream gains and losses
- Highly uncertain whether streamflow depletion will or may pose operational limitations
- Collaborate with neighboring basins to leverage efforts regionally

Sustainability Indicators
Summary Recon-Level "Risk Assessment"

- Categorically eliminate from consideration:
  - Seawater Intrusion (#3)
- Address but unlikely to pose operational constraints; focus on monitoring:
  - Reduction of Groundwater Storage (#2)
  - Degraded Water Quality (#4)
- Potential to pose operational constraints and require Projects and/or Management Actions:
  - Chronic Lowering of Groundwater Levels (#1)
  - Land Subsidence (#5)
  - Depletions of Interconnected Surface Water (#6)

Discussion