

Groundwater Conditions in Colusa County Relative to Final Groundwater Sustainability Plan Regulations

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Approach

- Governance is all about decision making
 - If important decisions will be made, then governance is important; otherwise, not so much
- What are the key decisions embedded in preparing Groundwater Management Plan (or Plans)?
- “Key decisions” are ones that could affect the availability and/or the cost of groundwater to overlying landowners
- Be thinking about: “How should GSA’s be formed to make these key decisions (and many others) appropriately?”

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
- Burning questions okay; please hold comments and discussion for later

Outline

- **Final Groundwater Sustainability Plan (GSP) Regulations**
 - Focus on Key Decisions embedded in GSP development
- **Groundwater Conditions and Potential Sustainability Challenges in Colusa County**
 - Implications to GSP Development
- **Thoughts on Delineating Management Areas**
- **Questions & Answers, Discussion**

GSP Regulations

- Finalized on May 18, 2016 (since last meeting)
- California Code of Regulations, Title 23. Waters, Division 2, Department of Water Resources, Chapter 1.5, Groundwater Management, Subchapter 2. Groundwater Sustainability Plans
 - Article 1. Introductory Provisions
 - Article 2. Definitions
 - Article 3. Technical and Reporting Standards
 - Article 4. Procedures
 - Article 5. Plan Contents
 - Article 6. Department Evaluation and Assessment
 - Article 7. Annual Reports and Periodic Evaluation by the Agency
 - Article 8. Interagency Agreements
 - Article 9. Adjudicated Areas and Alternatives

Article 5. Plan Contents

- Subarticle 1. Administrative Information
- Subarticle 2. Basin Setting
- Subarticle 3. Sustainable Management Criteria
- Subarticle 4. Monitoring Networks
- Subarticle 5. Projects and Management Actions

Key Decisions Embedded in GSP Development

- **Subarticle 3. Sustainable Management Criteria**
 - Defining “Undesirable Results”: do they exist now; will they potentially occur in the future?
 - Establishing “Minimum Thresholds” and “Measureable Objectives” for each Sustainability Indicator (groundwater levels, water quality, land subsidence, etc.)
- **Subarticle 5. Projects and Management Actions**
 - Identifying “Potential Projects and Management Actions” needed to achieve sustainable basin management

Key Decisions: Defining Undesirable Results

- For each Sustainability Indicator, do significant and unreasonable effects currently exist or could they develop in the future?

• Chronic Lowering of GW Levels	• Degraded Water Quality
• Reduction of GW Storage	• Land Subsidence
• Seawater Intrusion	• Depletions of Interconnected Surface Water

- Do not need to address Sustainability Indicators if the GSA can demonstrate that undesirable results are not present and are not likely to occur.

Key Decision: Establishing Minimum Thresholds and Measureable Objectives

- **Numeric, site-specific criteria for each Sustainability Indicator establishing a point at which, if exceeded, significant and unreasonable results may occur.**

• Chronic Lowering of GW Levels	• Degraded Water Quality
• Reduction of GW Storage	• Land Subsidence
• Seawater Intrusion	• Depletions of Interconnected Surface Water

- **Must be established to avoid causing undesirable results in adjoining basins**
- **Must evaluate effects on the interests of beneficial uses and users of groundwater or land uses and property interests**

Key Decision: Defining Projects and Management Actions

- **Describe Projects and Management Actions needed to observe Minimum Thresholds and Measureable Objectives**
- **Describe circumstances under which Projects or Management Actions shall be implemented**
- **Describe required legal authority and permitting and regulatory process to implement projects**
- **Explain expected benefits, costs and how costs will be met**

Key Decisions by Sustainability Indicator Matrix

Figure 1. Key Decisions Embedded in Preparation of Groundwater Sustainability Plans pursuant to the Sustainable Groundwater Management Act
Prepared by Davids Engineering
July 2016

Figure 1. Key Decisions Embedded in Preparation of Groundwater Sustainability Plans pursuant to the Sustainable Groundwater Management Act Prepared by Davids Engineering July 2016			Groundwater Sustainability Agency					
			Groundwater Sustainability Plan					
			Sustainability Goal: Essentially: Operate the subbasin within sustainable yield, with no Undesirable Results over time.					
			Sustainability Indicators					
Key Decisions Determinations that must be made during GSP development per Final GSP Regulations.			#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 (§ 354.26) For each Sustainability Indicator, do significant and unreasonable effects currently exist or could they develop in the future?					Not Applicable			
Minimum Threshold (§ 354.28) Numeric, site-specific criteria for each Sustainability Indicator establishing a point at which, if exceeded, significant and unreasonable results may occur.					Not Applicable			
Measureable Objective and 5-Year Interim Milestones (§ 354.44) Numeric, site-specific criteria for each Sustainability Indicator describing prudent operational limits with "reasonable margin of operational flexibility" factored in.					Not Applicable			
Projects and Management Actions (§ 354.44) Descriptions of projects and management actions the GSA has determined will achieve the sustainability goal for the basin.					Not Applicable			

Pre-existing 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)

Sustainability Indicator #3: Seawater Intrusion

- Physically impossible; therefore, exempt

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)

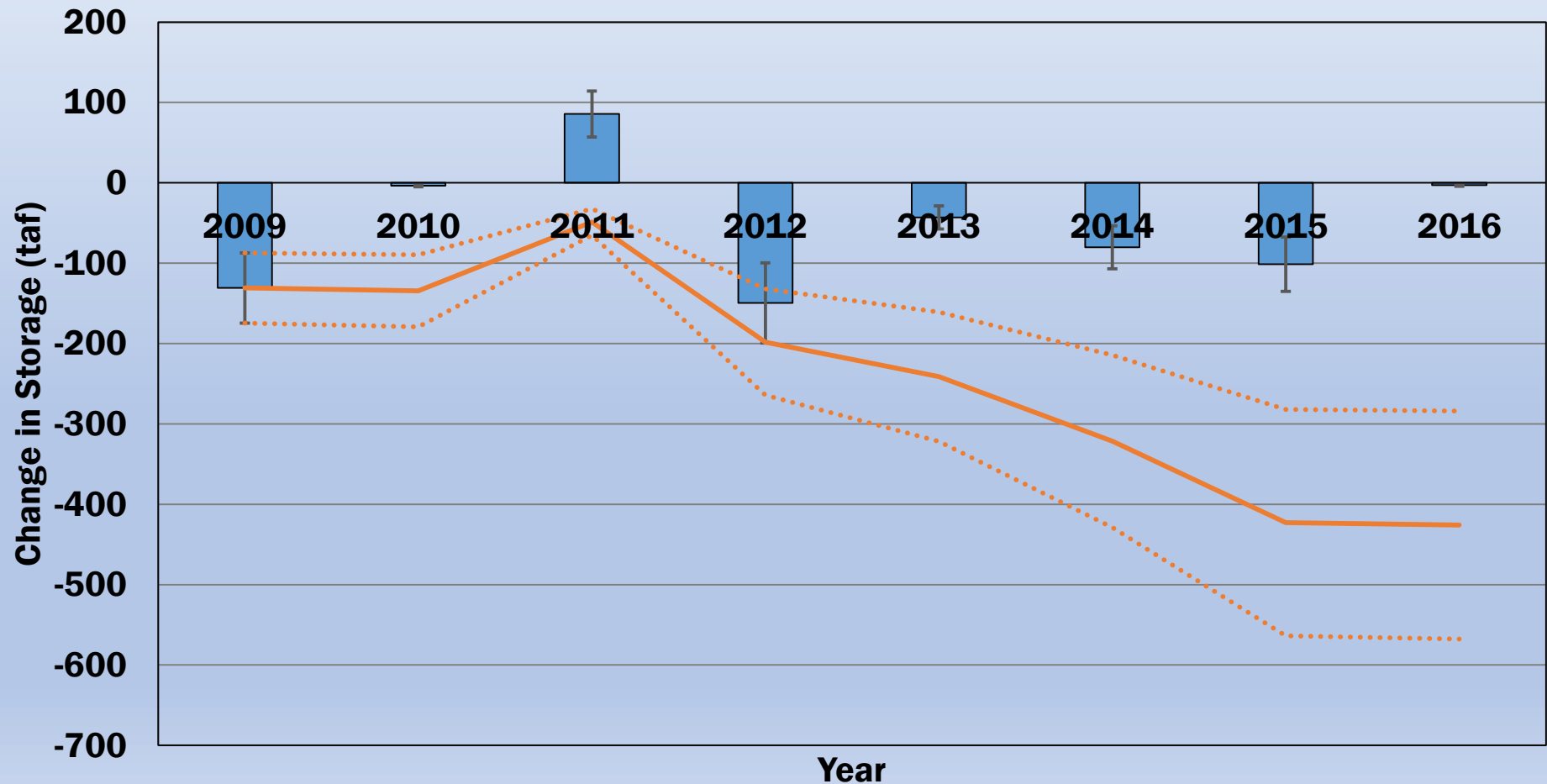
- **Colusa Subbasin**
 - ~13 million acre-feet basinwide
 - ~5.5 million acre-feet in Colusa County (43%)
- **West Butte Subbasin: ~3 MAF (basinwide)**
 - ~3 million acre-feet basinwide
 - ~0.7 million acre-feet in Colusa County (24%)
- **Countywide GW Storage Capacity = ± 6.2 million acre-feet**

Sustainability Indicator #2:

Reduction of Groundwater Storage

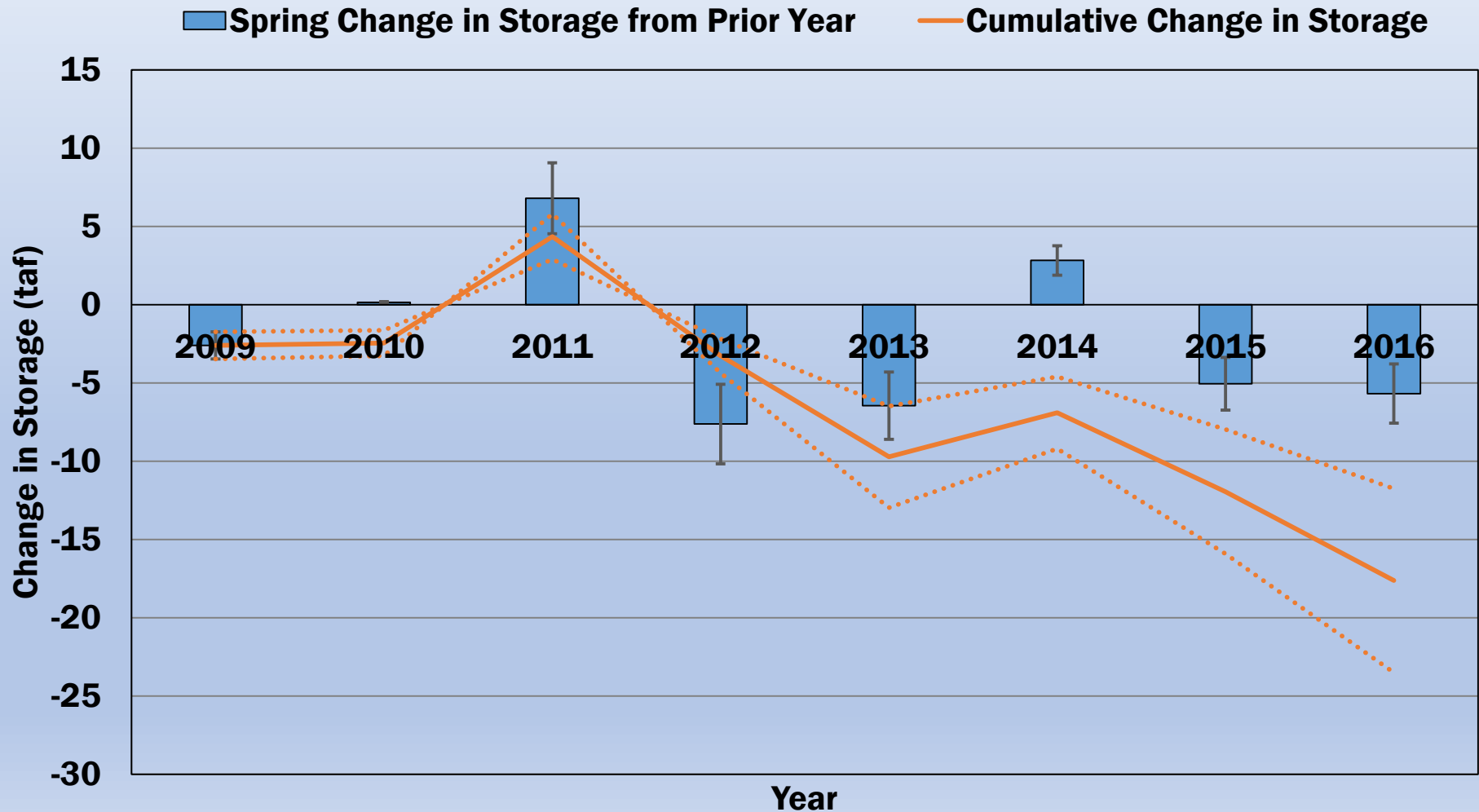
Colusa and West Butte Subbasins in Colusa County (2009 through 2016)

Spring Change in Storage from Prior Year Cumulative Change in Storage



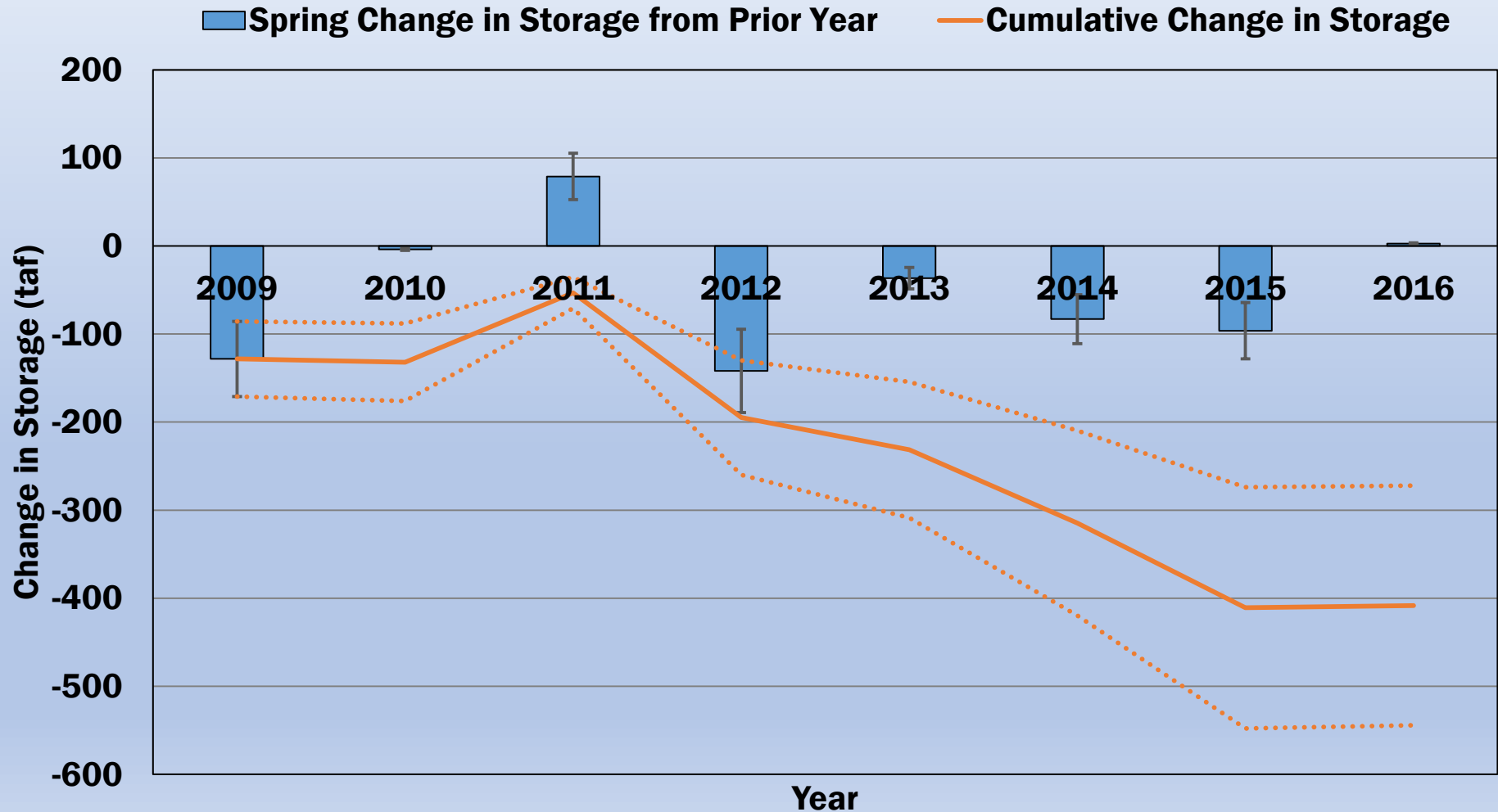
Sustainability Indicator #2: Reduction of Groundwater Storage

West Butte Subbasin in Colusa County (2009 through 2016)

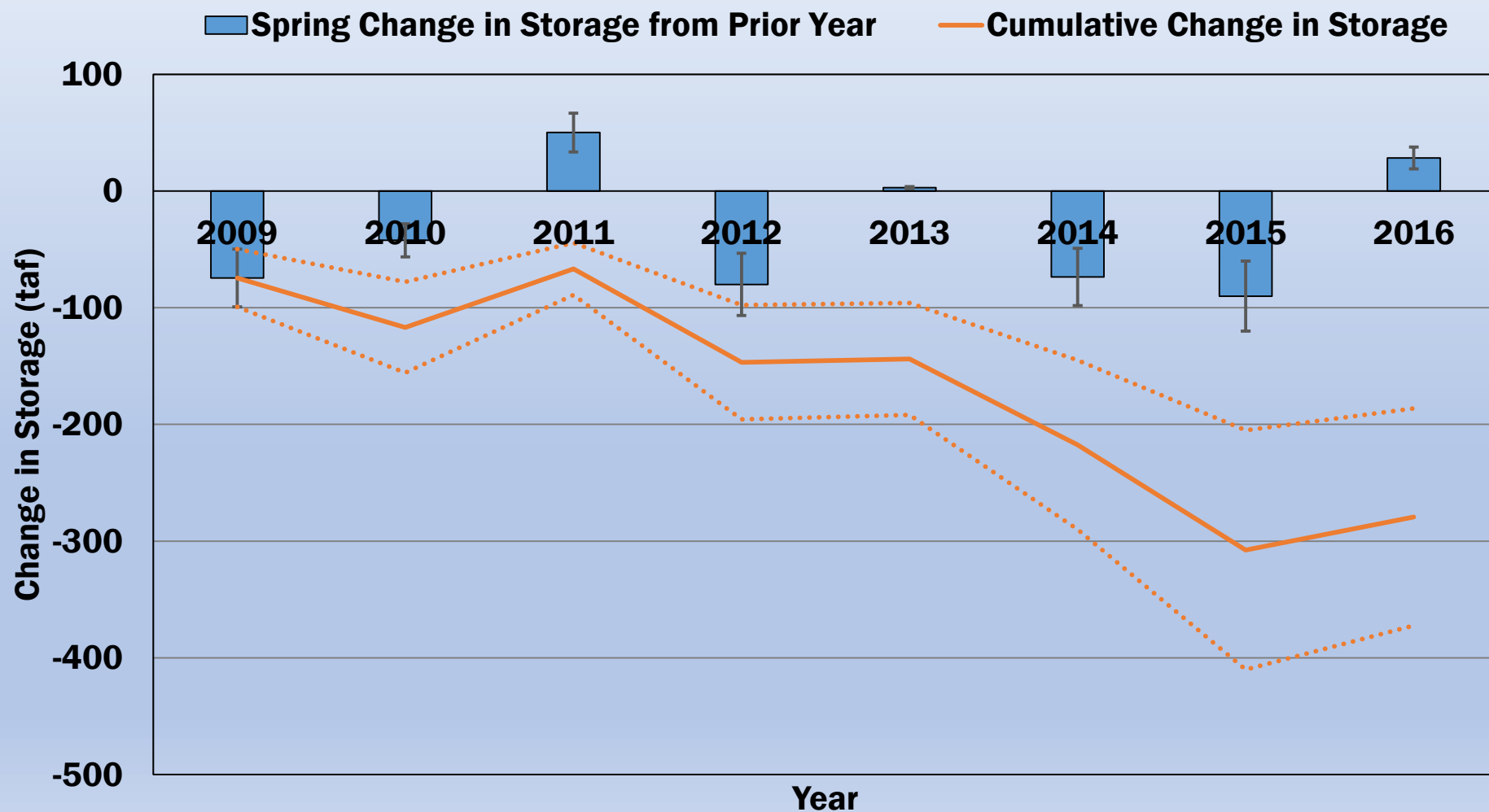


Sustainability Indicator #2: Reduction of Groundwater Storage

Colusa Subbasin in Colusa County (2009 through 2016)

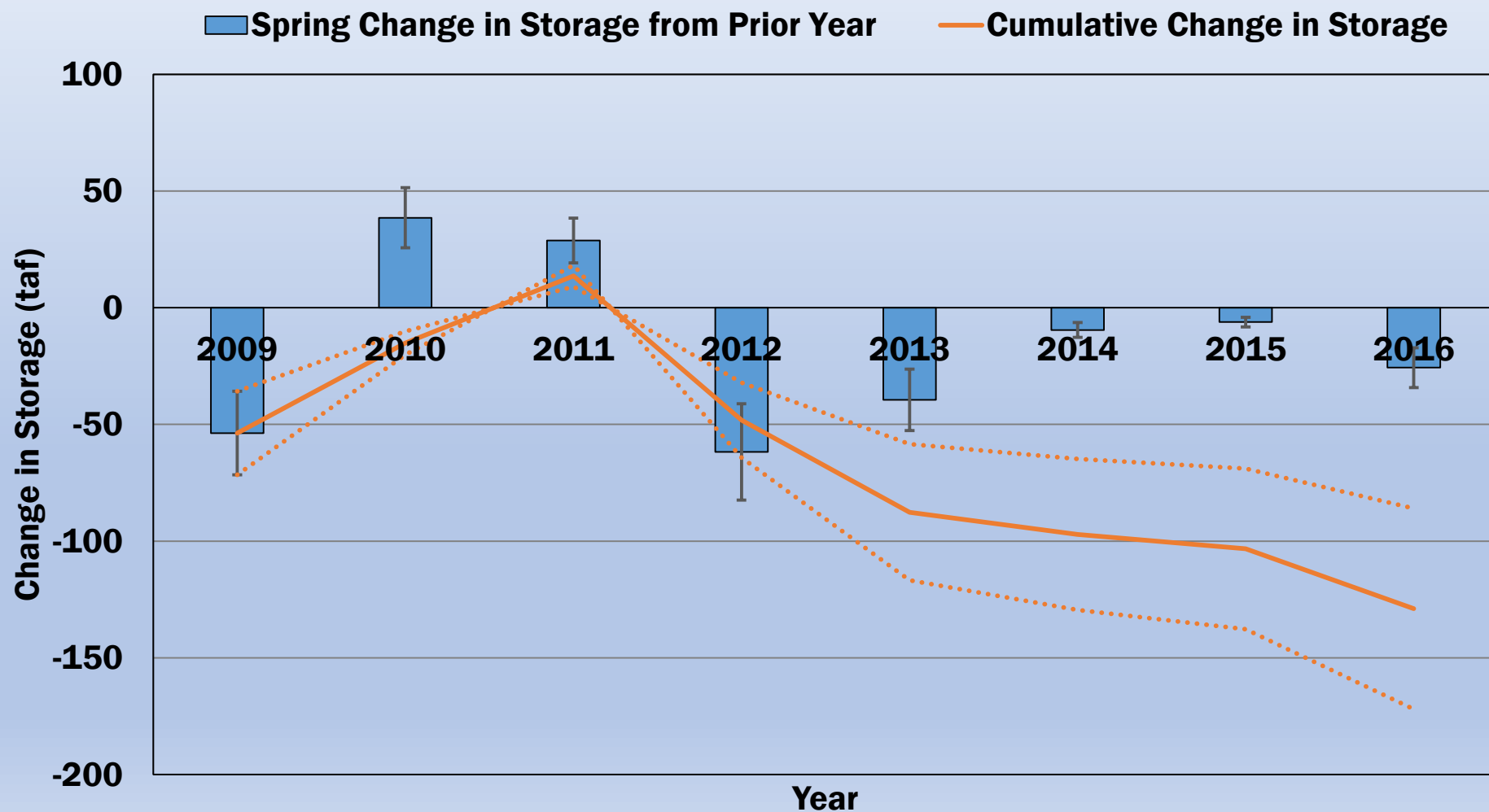


Sustainability Indicator #2: Reduction of Groundwater Storage Colusa Subbasin in AOI (2009 through 2016)



Sustainability Indicator #2: Reduction of Groundwater Storage

Colusa Subbasin outside AOI (2009 through 2016)



Sustainability Indicator #2: Reduction of Groundwater Storage

Crystal Ball:

- **Will need to address in GSP**
- **Recent reductions in groundwater storage (during the past 8 years) are modest relative to the total volume of groundwater in storage (<10%)**
- **Other Sustainability Indicators (e.g., GW levels, subsidence, or streamflow depletion) are likely to pose operational limits before depletion of storage**

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 to comply with regulatory standards
 - Drinking water regs
 - Basin Water Quality Control Plan

Sustainability Indicator #4:

Degraded Water Quality

(Findings from 2008 Colusa County GMP)

- **WQ raised as an issue of concern during outreach: salinity, arsenic, manganese**
- **GW quality generally suitable for ag and domestic uses, with some exceptions**
 - **Localized elevated salinity north of Hwy 20 between Colusa and Williams**
 - **Elevated boron SW of Arbuckle (crop limitations?)**
 - **Elevated manganese in eastern portion of County (taste and odor issue, not a health threat)**
- **Hydrogeology of County as it relates to WQ is not well understood**

Sustainability Indicator #4: Degraded Water Quality

Crystal Ball:

- **Relationships between basin operation (e.g. water levels) and water quality are not sufficiently understood to conclude that undesirable effects have or will be caused by operational factors.**
- **Water quality will definitely need to be addressed in GSP**
- **Unlikely that water quality will or may pose operational limitations, at least until additional investigations have been conducted**

Sustainability Indicator #5: Land Subsidence

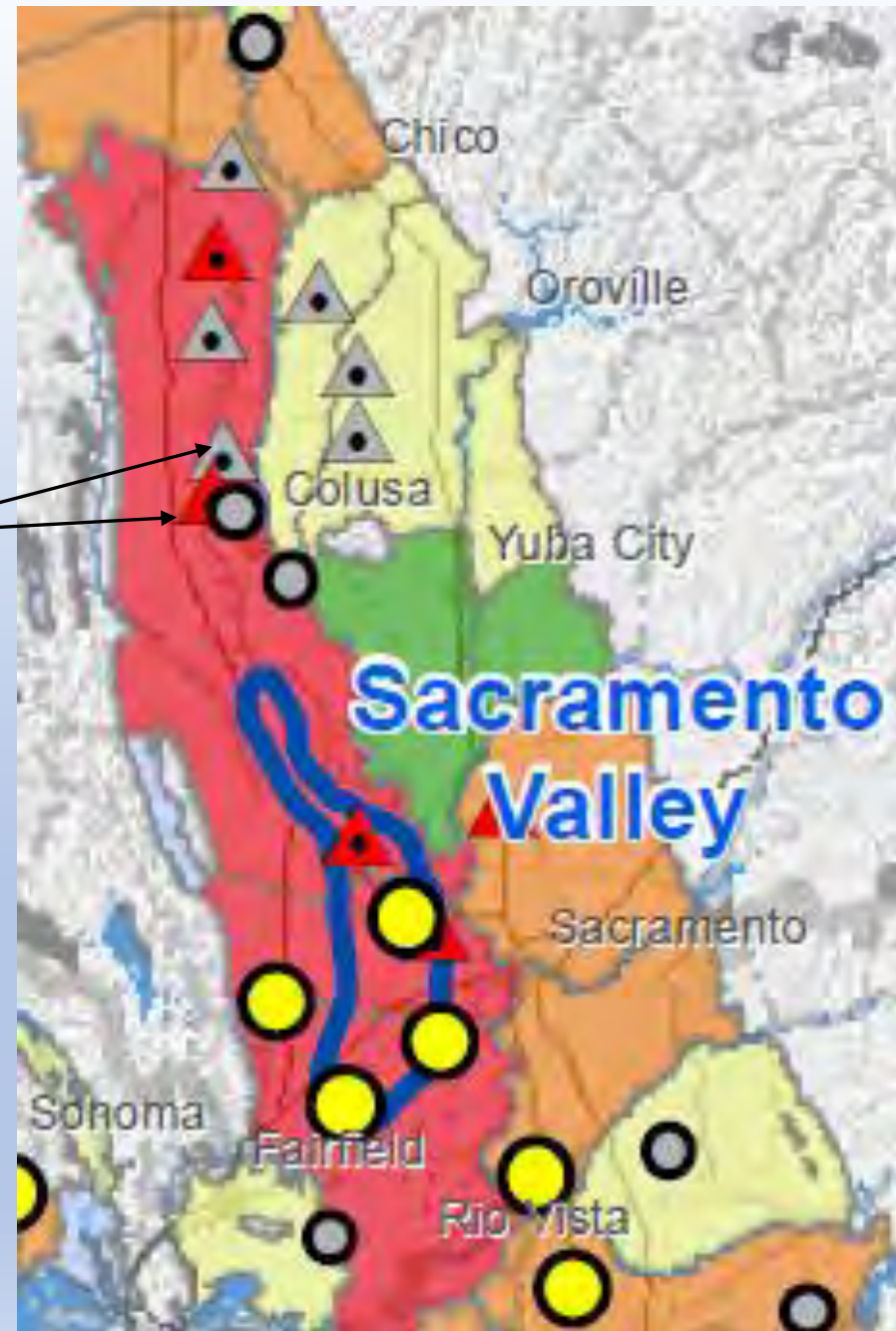
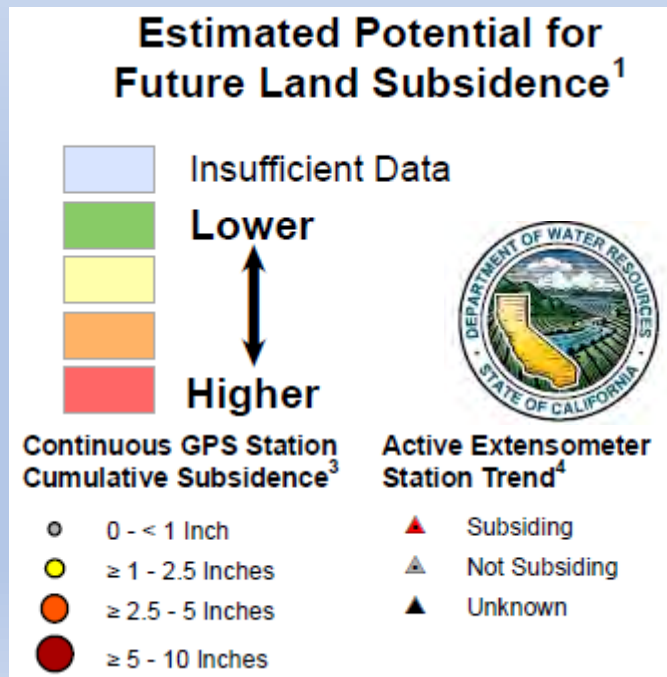
- **Minimum Threshold:** “...the rate and extent of subsidence that substantially interferes with land surface uses and may lead to undesirable results.” § 354.28 (c) (5)
- **Potential Undesirable Results:**
 - Permanent loss of aquifer storage capacity
 - Damage to foundations, roads, bridges, other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

Sustainability Indicator #5: Land Subsidence

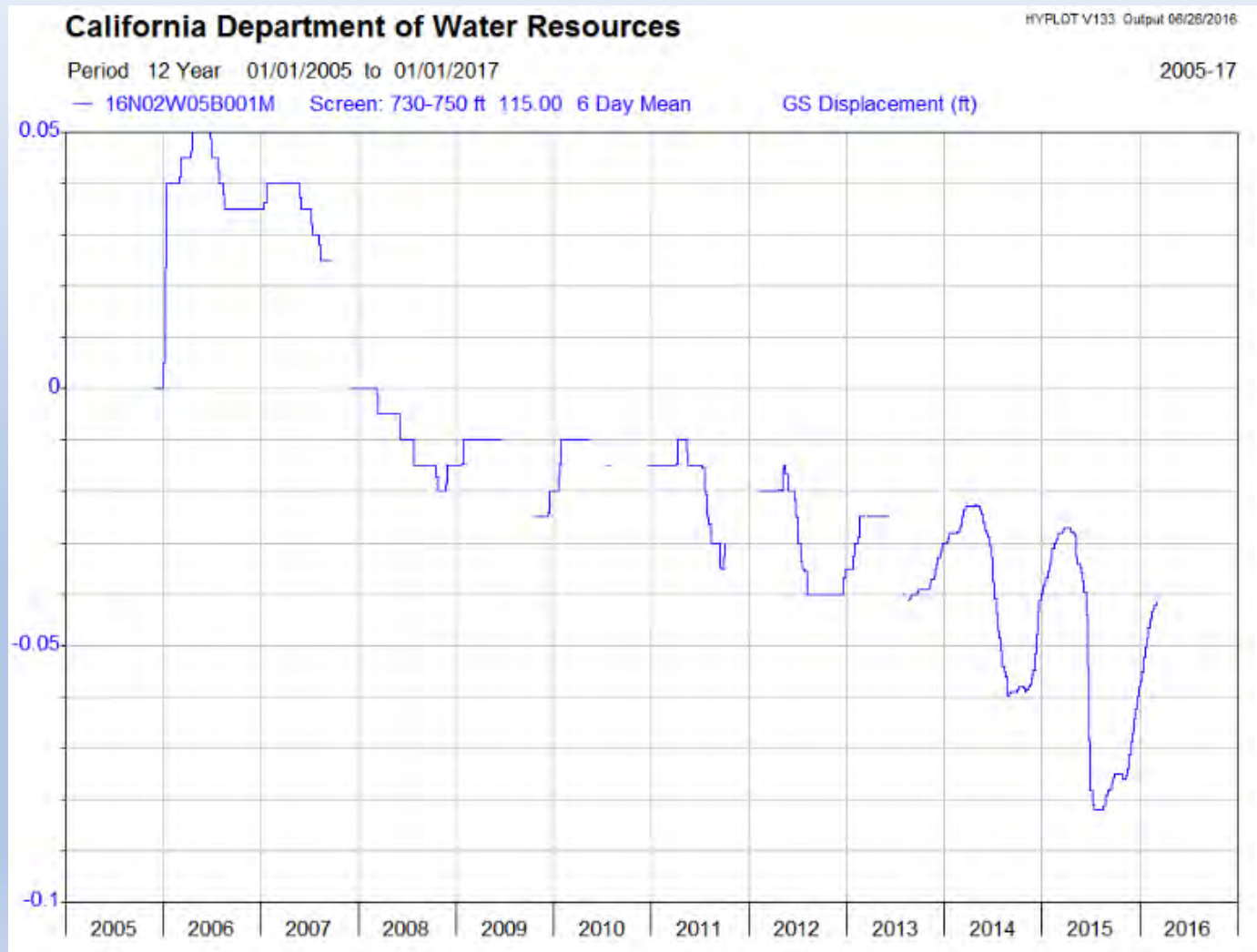
- **Summary of Recent, Historical and Estimated Potential for Future Land Subsidence in California (DWR 2014)**
- **Existing subsidence monitoring:**
 - **Two extensometer wells in County**
 - **28 GPS stations in County as part of DWR/USBR Sacramento Valley GPS Subsidence Project**
 - Collaborative effort with various Sac Valley local agencies
 - Originally surveyed in 2008
 - Recently resurveyed but results not yet available
- **Interferometric Synthetic Aperture Radar (InSAR) Study (NASA, 2015)**

Sustainability Indicator #5: Land Subsidence

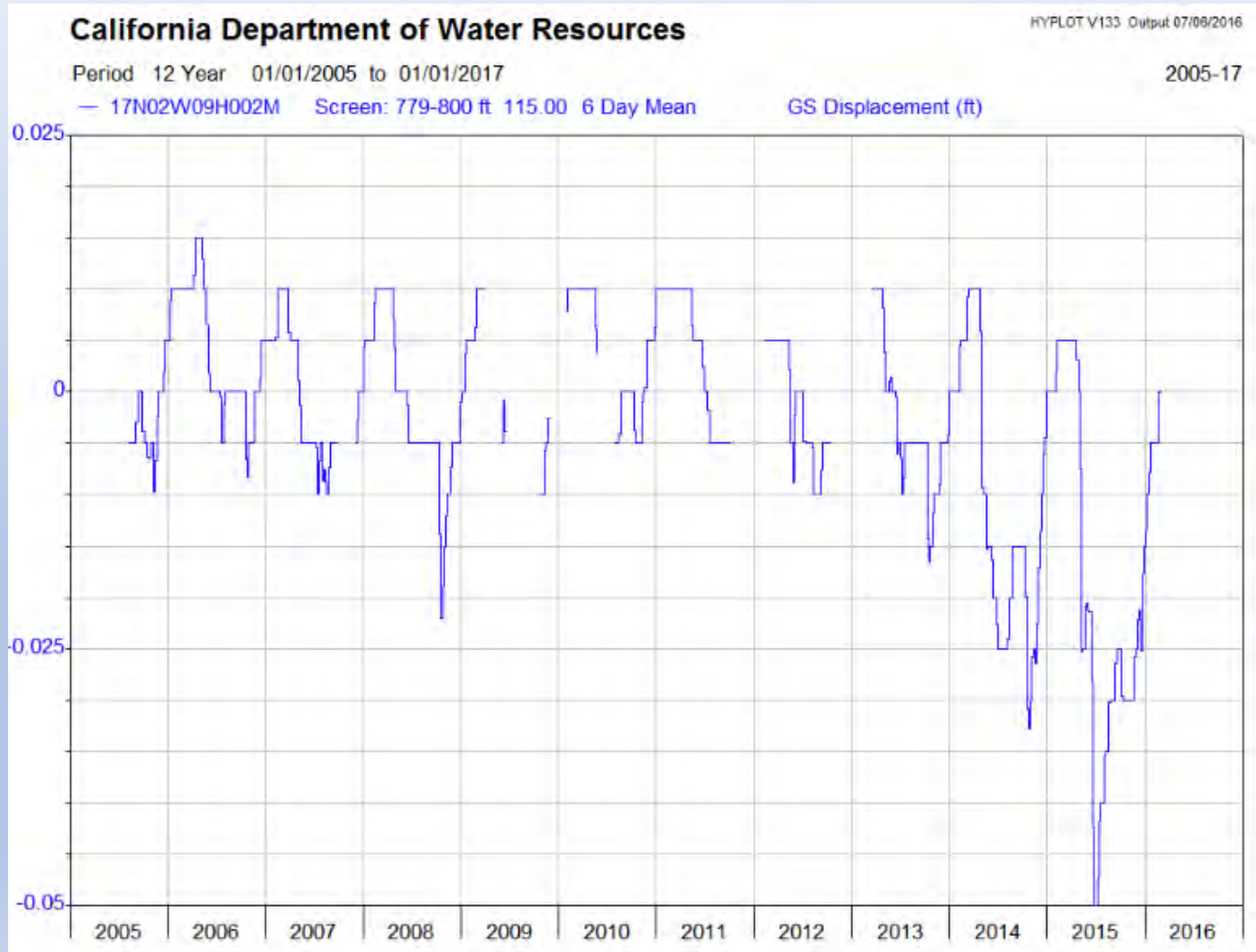
Two Colusa County Extensometer Wells



Sustainability Indicator #5: Land Subsidence: Extensometer Data

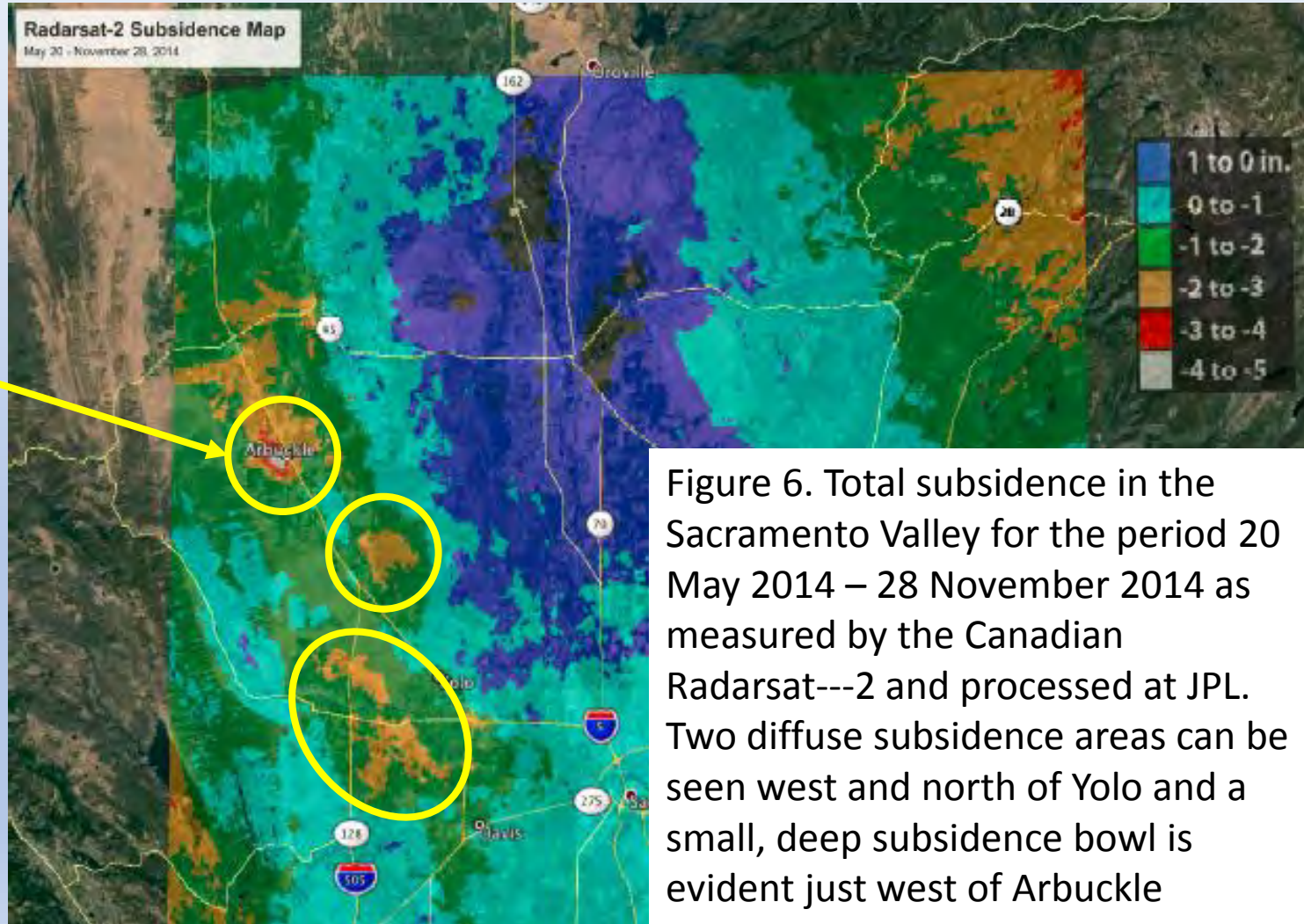


Sustainability Indicator #5: Land Subsidence: Extensometer Data



Sustainability Indicator #5: Land Subsidence: NASA Report 2015

“...an unusually small heavily subsiding area just west of Arbuckle showed a maximum subsidence of about 5 inches”.



Sustainability Indicator #5: Land Subsidence

Crystal Ball:

- **There is known potential for land subsidence in the County and some early signs of actual subsidence**
 - **Will know more when new GPS survey results are published**
- **Land subsidence will definitely need to be addressed in GSP**
- **Highly uncertain whether land subsidence will or may pose operational limitations**

Sustainability Indicator #6

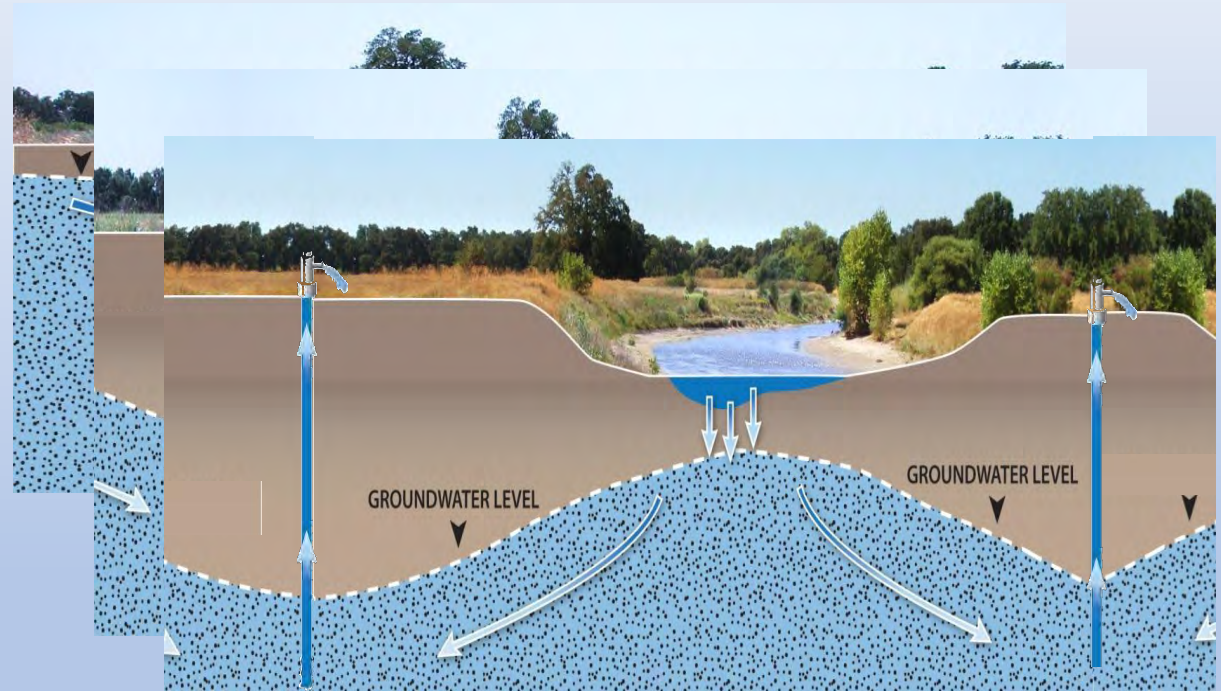
Depletions of Interconnected Surface Water

- **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 “Groundwater Dependent Ecosystems” (GDE’s) – TNC leading this
 - Reduced water availability to legal users of surface water

Sustainability Indicator #6

Depletions of Interconnected Surface Water

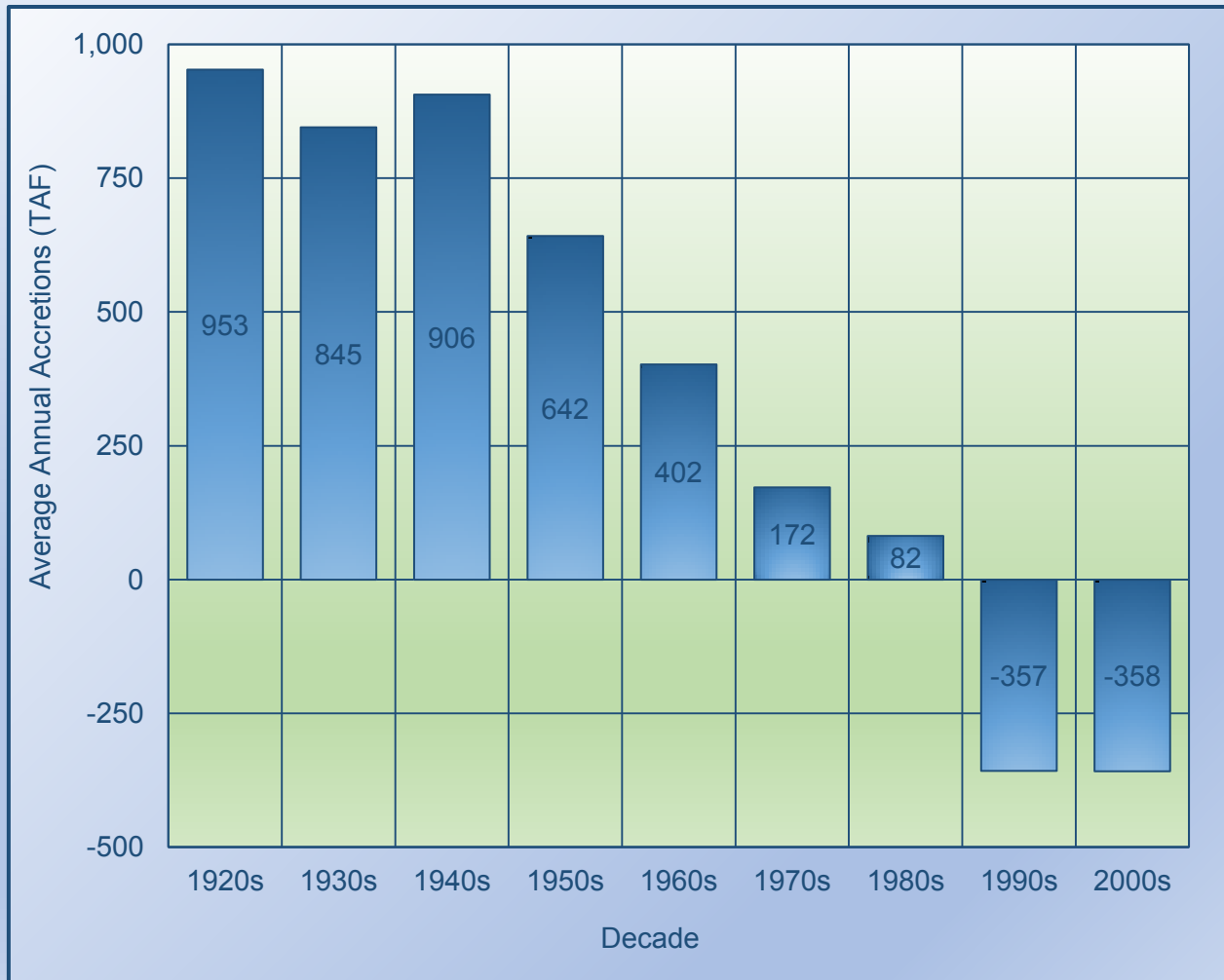
- Interaction depends on relative groundwater levels and properties of streambed and aquifer
- The uppermost groundwater sustains Groundwater Dependent Ecosystems, and river and stream flows



Source: The Nature Conservancy

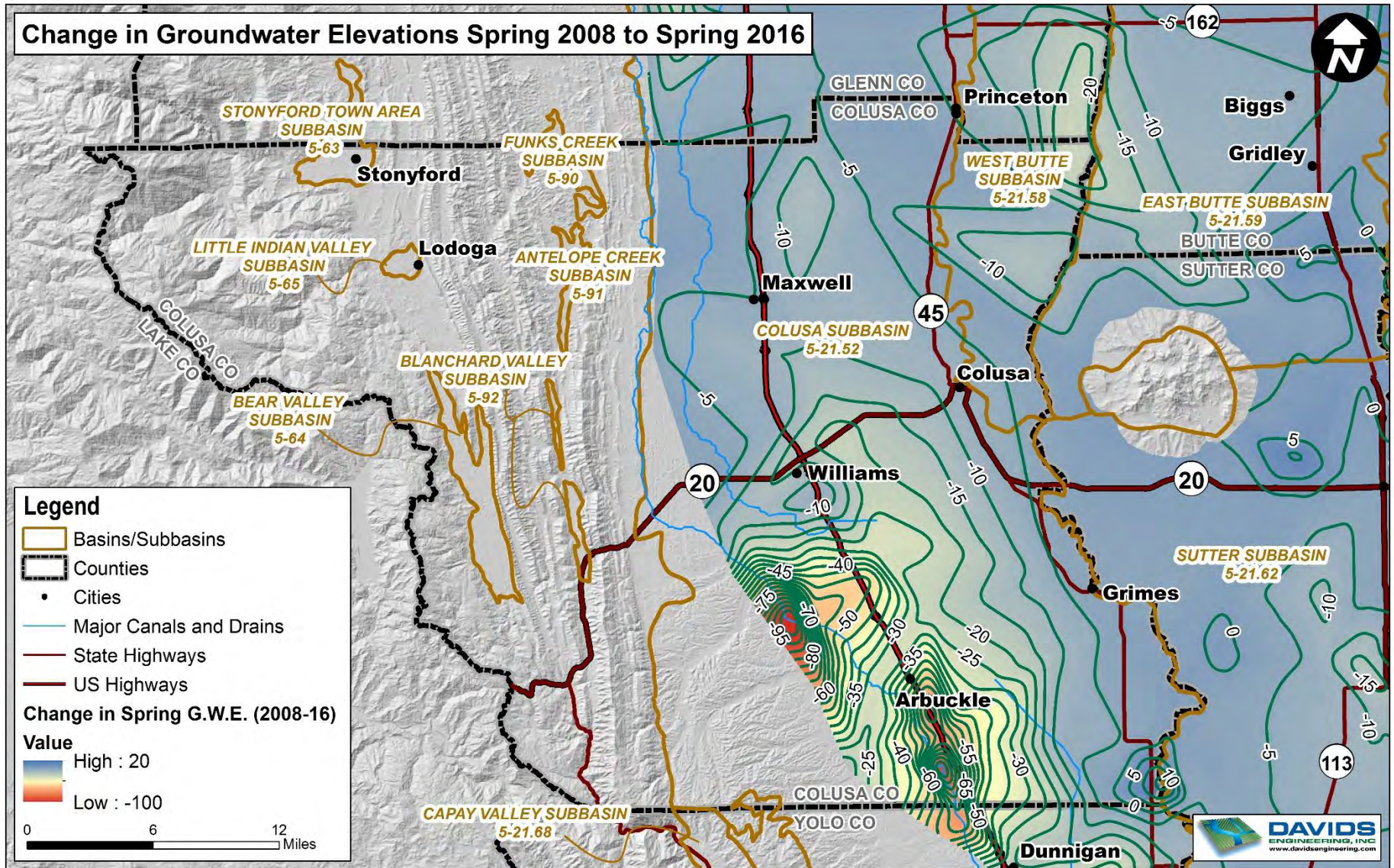
Sustainability Indicator #6

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.

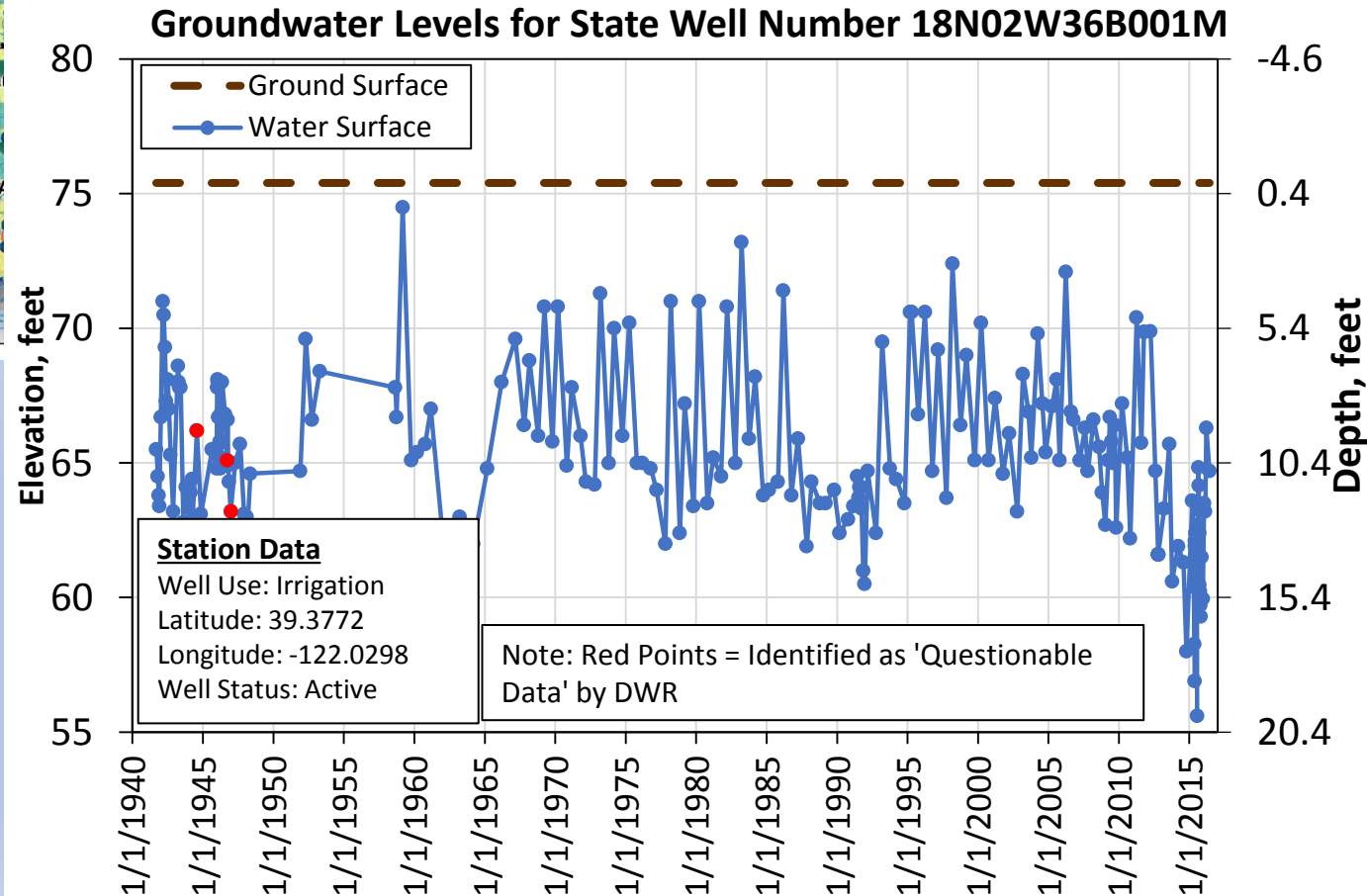
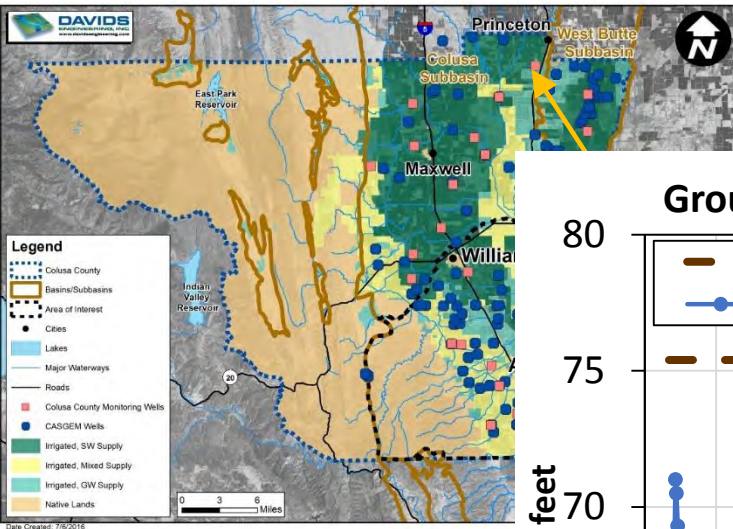
Change in Groundwater Elevations Spring 2008 to Spring 2016



Date Created: 7/13/2016

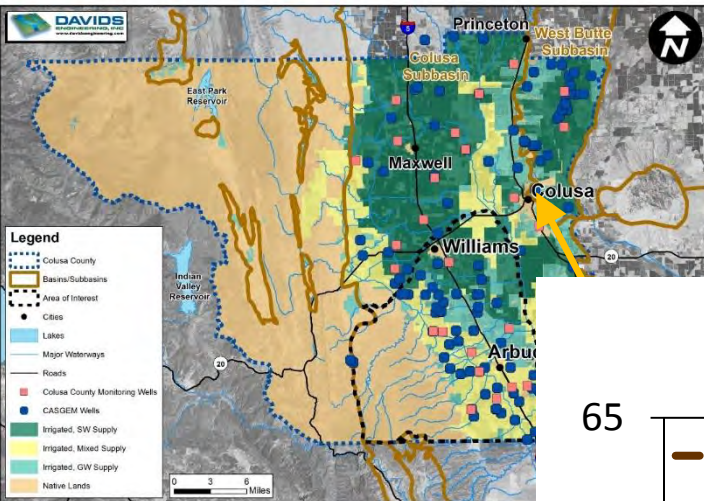
Sustainability Indicator #6

Depletions of Interconnected Surface Water

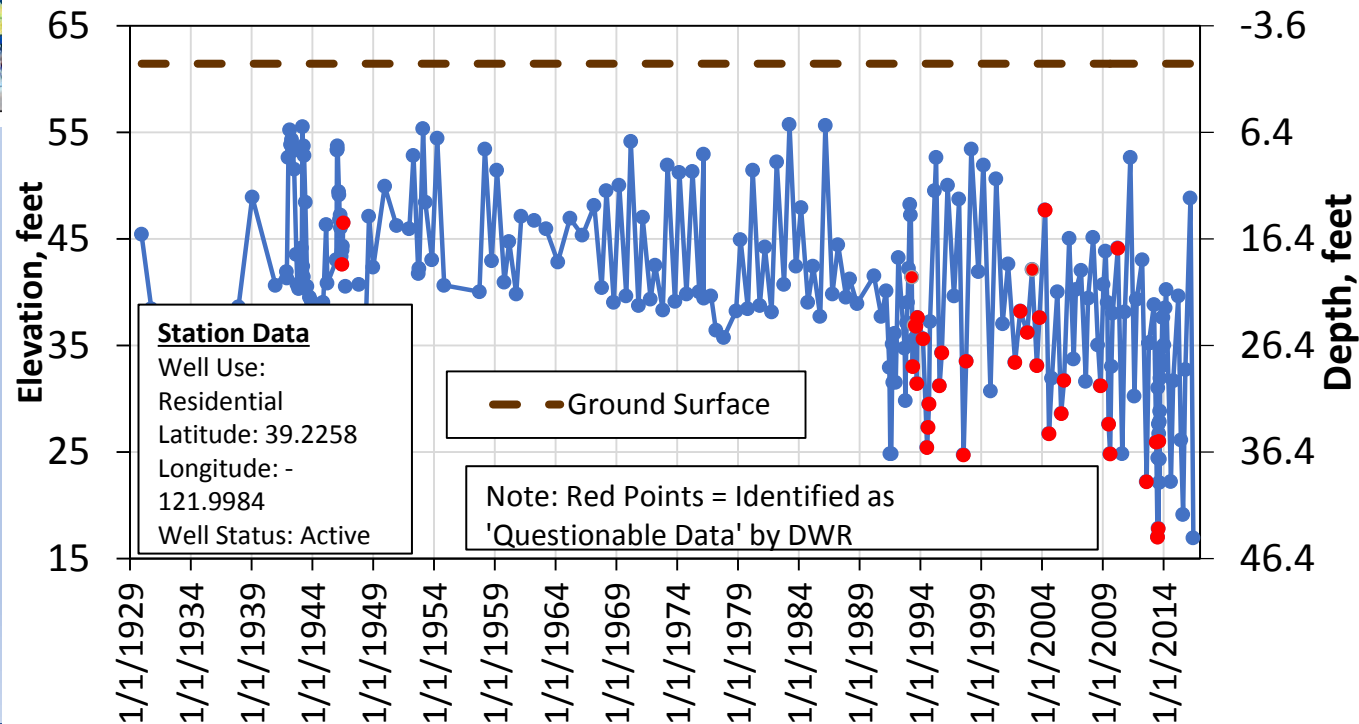


Sustainability Indicator #6

Depletions of Interconnected Surface Water

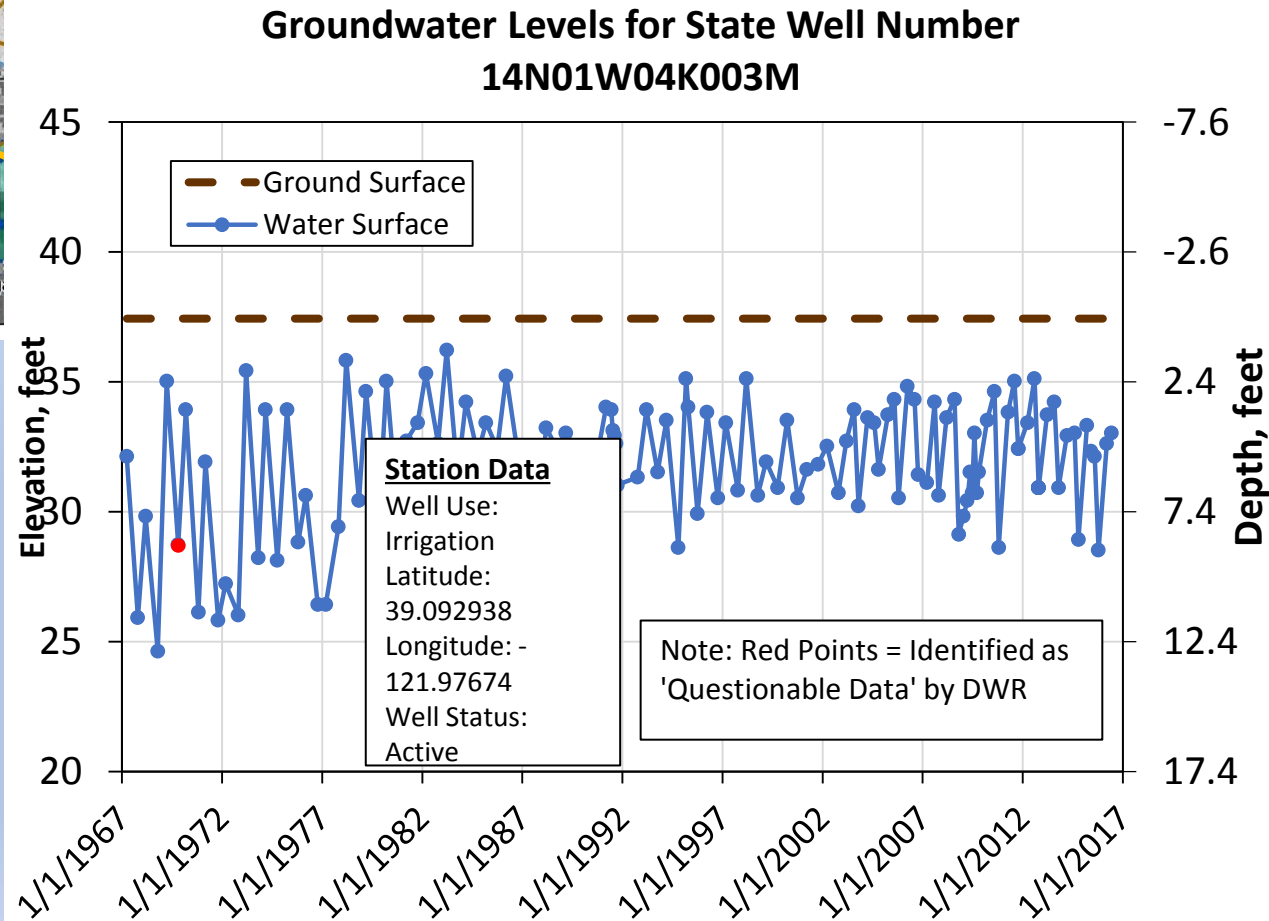
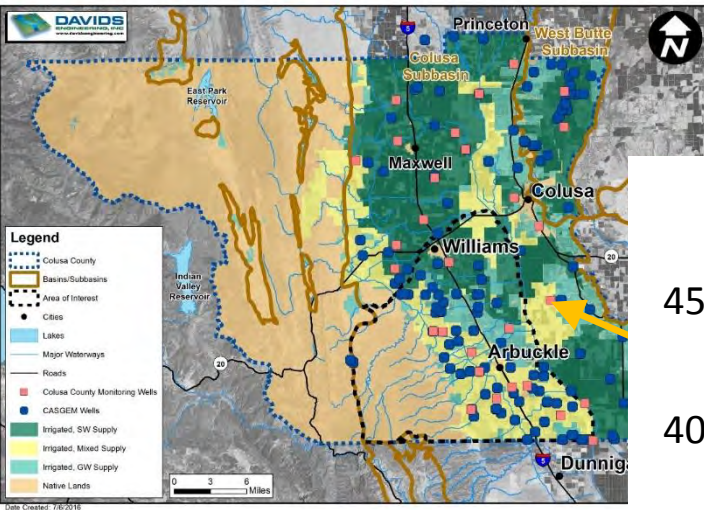


Groundwater Levels for State Well Number
16N01W20F001M



Sustainability Indicator #6

Depletions of Interconnected Surface Water



-7.6

-2.6

Depth, feet

7.4

12.4

17.4

Elevation, feet

45

40

35

30

25

20

1/1/1967
1/1/1972
1/1/1977
1/1/1982
1/1/1987
1/1/1992
1/1/1997
1/1/2002
1/1/2007
1/1/2012
1/1/2017

Ground Surface
Water Surface

Station Data
Well Use:
Irrigation
Latitude:
39.092938
Longitude: -
121.97674
Well Status:
Active

Note: Red Points = Identified as 'Questionable Data' by DWR

Sustainability Indicator #6

Depletions of Interconnected Surface Water

- **Unofficial DWR Stance**
 - Anticipating that effects on both Groundwater Dependent Ecosystems and streamflow depletion may become significant issues in the Sacramento Valley
 - Let local agencies define the challenges, recognizing that some local agencies might be from outside the Sacramento Valley
 - Working on technical tools to assist local agencies
 - C2VSim Model Update (fine grid)
 - Best Management Practices (BMPs) for local agencies to consider adopting for monitoring and analyzing effects of declining groundwater elevations

Sustainability Indicator #6

Depletions of Interconnected Surface Water

Crystal Ball:

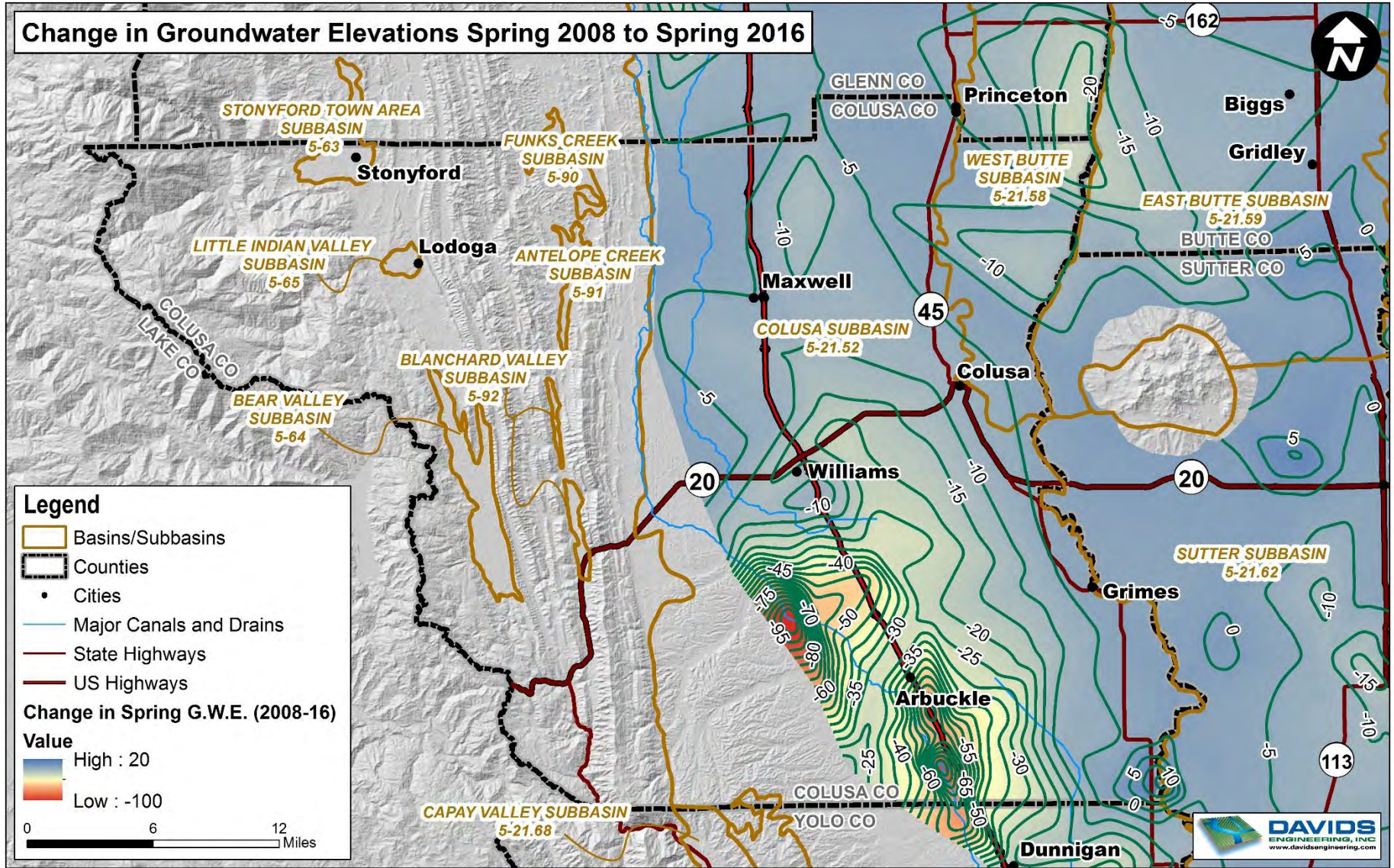
- **Potential effects of declining groundwater levels on GDE's and streamflow widely recognized, but physical relationships poorly understood**
- **Will definitely need to be addressed in GSP**
 - **TNC developing tools to assist in GSP preparation**
- **With respect to Sacramento River, potential effects are cumulative among subbasins**
- **Highly uncertain whether land subsidence will or may pose operational limitations**

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.”**
- **Potential Undesirable Results:**
 - Well stranding
 - Increased well construction costs
 - Increased groundwater pumping costs
 - Inelastic land subsidence
 - Streamflow depletion
 - Impacts to Groundwater Dependent Ecosystems
 - Induced water quality degradation
 - Others?

Change in Groundwater Elevations Spring 2008 to Spring 2016



Date Created: 7/13/2016

AOI Water Balance Results

Presented to Board of Supervisors in January 2016

- **Net Recharge in the AOI over the most recent nine-year period (2007 through 2015) has been about 63,000 AF per year less than the preceding nine-year period (1998 through 2006)**
- **About one-sixth of the reduction in Net Recharge is associated with land use (primarily crop) changes, and five-sixths due to “other factors”, generally associated with “drought”**
- **“Drought” (beginning in 2007) has had the dominant effect on declining groundwater levels**
 - **Reduced surface water availability**
 - **Reduced winter precipitation**

AOI Water Balance Results

Presented to Board of Supervisors in January 2016

- **Current groundwater conditions reflect the accumulation of nine years of dry conditions (as well as land use changes)**
- **If “Normal” conditions ensue, it likely will take multiple years for groundwater levels to recover**
- **The rate of recovery could be hastened by increasing use of supplemental surface water in the mixed supply and groundwater supply areas**
- **The rate of recovery will be slowed to the extent that recent trends toward relatively high water use crops continue**

Sustainability Indicator #1

Chronic Lowering of Groundwater Levels

Crystal Ball:

- **Will definitely need to be addressed in GSP, despite the fact that contributing factors up to this point are primarily drought related**
- **Minimum Thresholds, Measureable Objectives and Interim Milestones will need to be established in the GSP, along with Projects and Management Actions**
- **Implementation actions possible if drought, crop intensification continues**
- **A sufficiently reliable groundwater flow model will be needed during GSP development**

Sustainability Indicators

Summary “Risk Assessment”

- Will or may be able to remove from consideration:
 - Seawater Intrusion (#3)
- Will need to address but unlikely to pose operational constraints, at least in near term:
 - Reduction of Groundwater Storage (#2)
 - Degraded Water Quality (#4)
- “Wildcards” with known, significant potential for undesirable effects but highly uncertain operational implications:
 - Land Subsidence (#5)
 - Depletions of Interconnected Surface Water (#6)
- Significant risk of imposing operational constraints:
 - Chronic Lowering of Groundwater Levels (#1)

How should governance be structured to make key decisions appropriately?

Thoughts on Management Areas

Management Areas

Described Differently in the Regs

- “...an area within a basin for which the Plan may identify different minimum thresholds, measureable objectives, monitoring or projects and management actions based on water use sector, water source type, geology, aquifer characteristics, or other factors.” § 351 (r)
- “Each Agency may define one or more management areas within a basin if the Agency has determined that creation of management areas will facilitate implementation of the plan.”

Potential Themes for Delineating Management Areas

- Similar institutional factors
- Physical connectedness
 - Upslope-downslope groundwater flow
- Shared groundwater challenges and similar likelihood that potential projects or management actions will be needed
 - Areas where Measureable Objectives may not be met
- Relative benefit from GW use

Note: Delineation of Management Areas does not preclude coordinated actions across Management Area boundaries.

Discussion