

DWR Update - Subsidence

Roy Hull, Engineering Geologist
CA Department of Water Resources

*Groundwater and Geologic Investigations Section
Northern Region Office, Red Bluff*





Topics



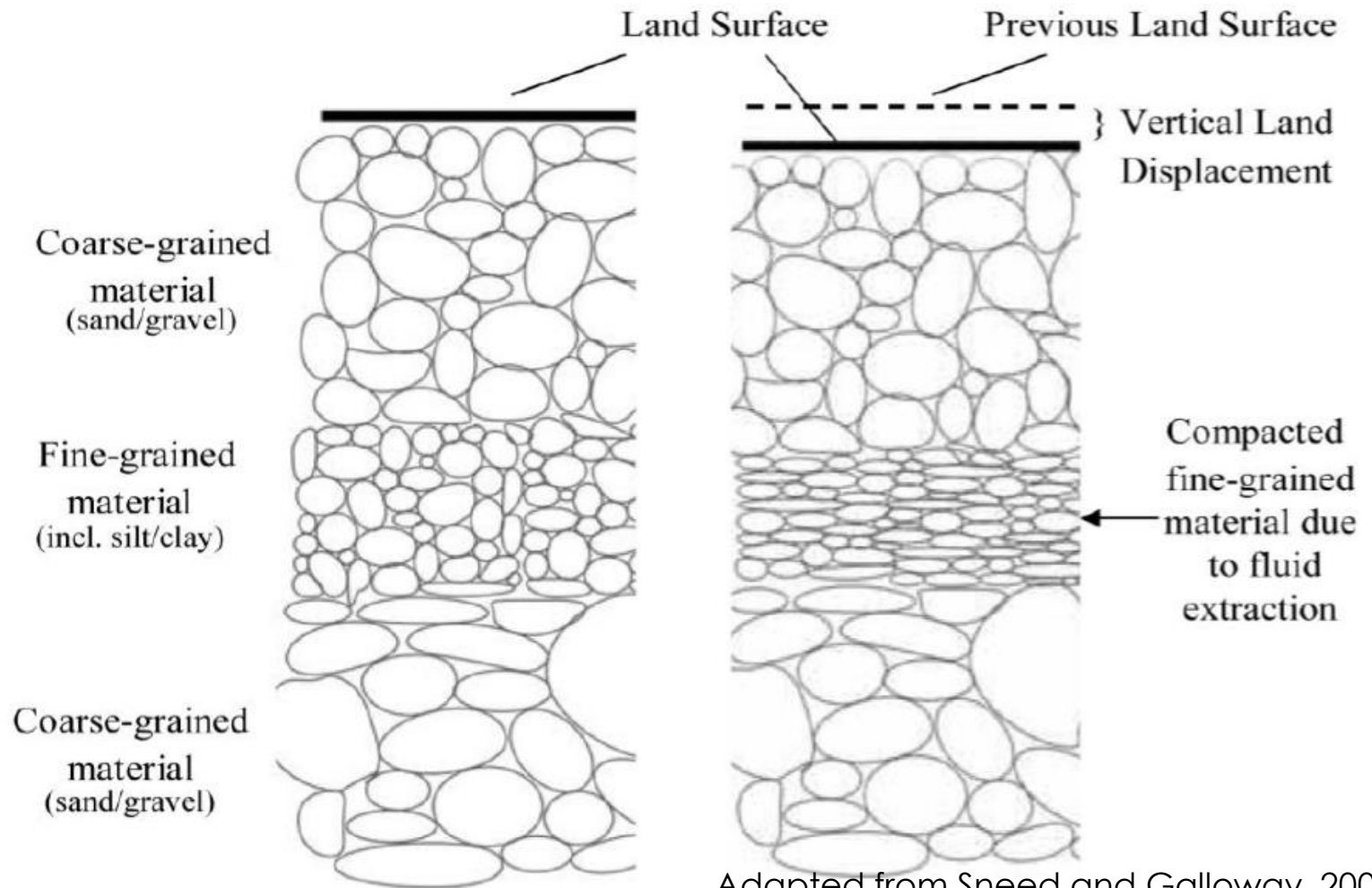
- Background
 - Basics of inelastic subsidence
 - Sacramento Valley GPS Grid
 - Recorded inelastic subsidence in Glenn County
 - Recorded inelastic subsidence in Yolo County
 - NASA/JPL Central Valley Remote Sensing Report
- GPS Survey Results – Colusa
- Colusa County Conditions
- Other subsidence information & SGMA
- Pending GPS Survey – Sacramento Valley



The basics of inelastic subsidence

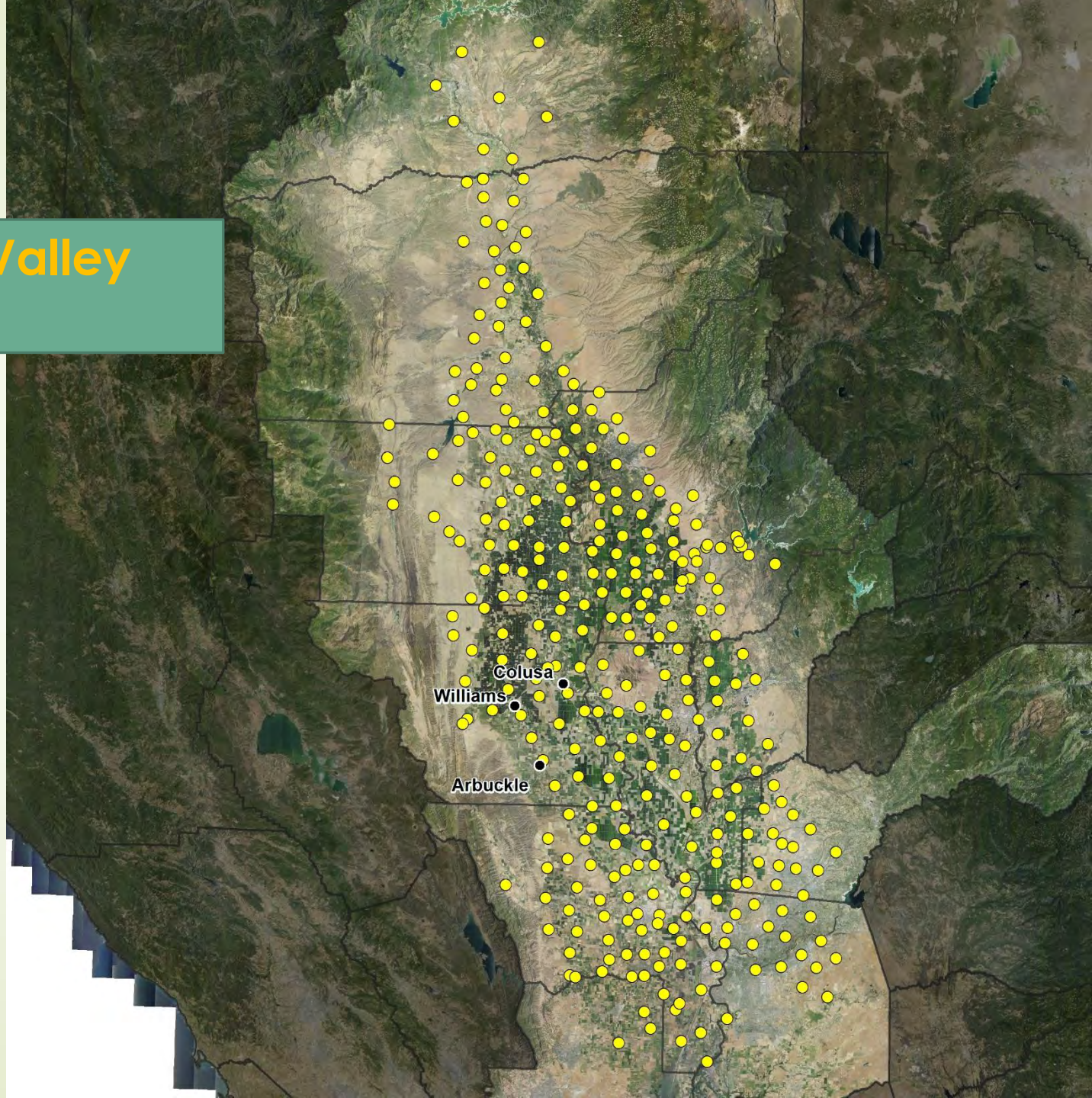
- Inelastic compaction occurs when the structure of the clays is compromised during compaction, such that it is unable to expand to its original thickness even when groundwater levels rise to pre-pumping levels.
- 

The basics of inelastic subsidence



Adapted from Sneed and Galloway, 2000

Sacramento Valley GPS Grid





Recorded inelastic subsidence in Glenn County

Legend:

- ▲ EASTERN MONUMENTS
- ▲ WESTERN MONUMENTS

Monument Example

BIGW	Monument Name
-0.12	Difference in Inches

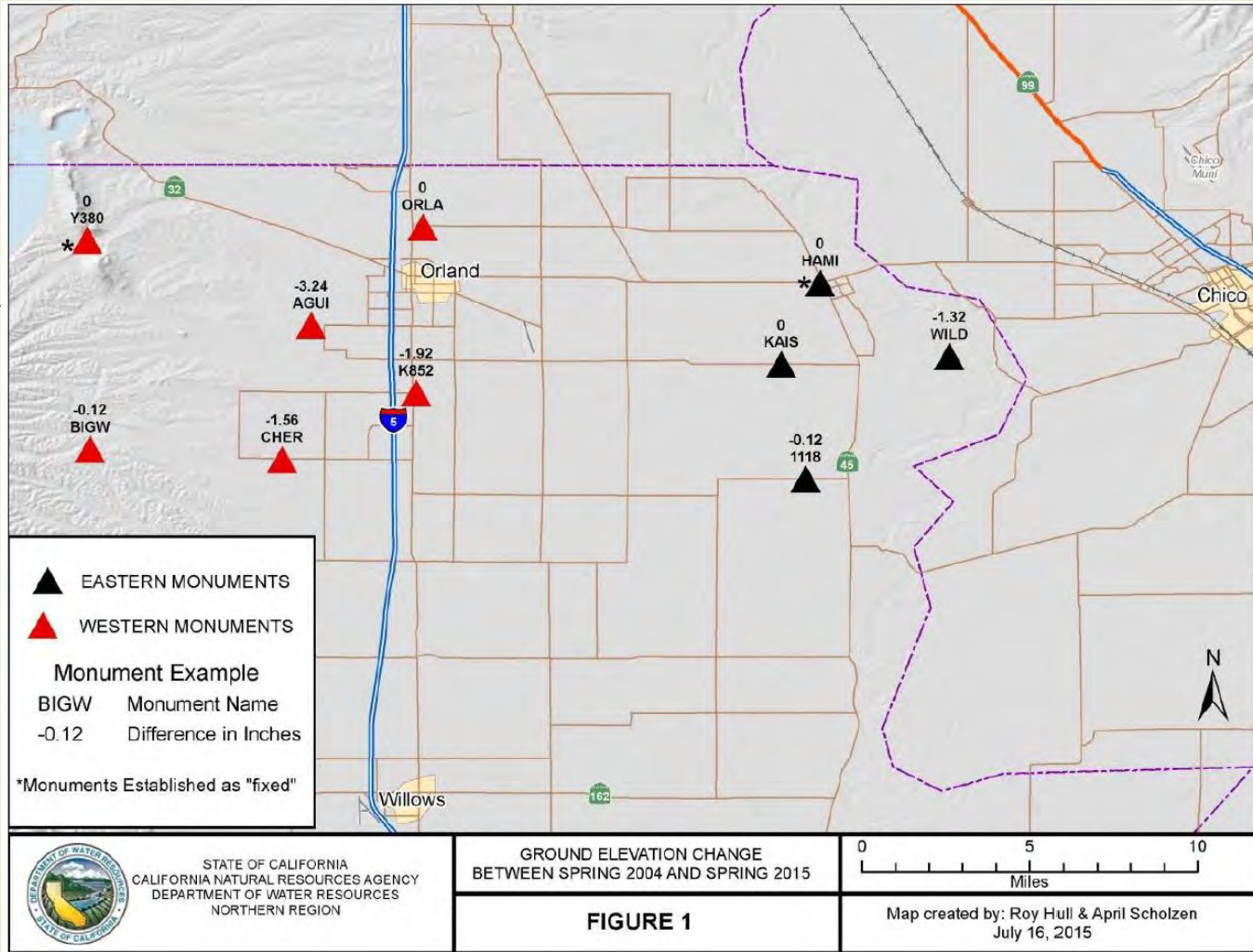
*Monuments Established as "fixed"

Map Data:

Monument Name	Elevation Change (Inches)	Type
Y380	0	Western
AGUI	-3.24	Western
BIGW	-0.12	Western
CHER	-1.56	Western
ORLA	0	Western
K852	-1.92	Western
KAIS	0	Eastern
HAMI	0	Eastern
1118	-0.12	Eastern
WILD	-1.32	Eastern

Figure 1: GROUND ELEVATION CHANGE BETWEEN SPRING 2004 AND SPRING 2015

Map created by: Roy Hull & April Scholzen
July 16, 2015





Recorded inelastic subsidence in Yolo County

Yolo County



Zamora Extensometer

California Department of Water Resources

HYPLOT V133 Output 08/24/2016

Period 25 Year 01/01/1992 to 01/01/2017

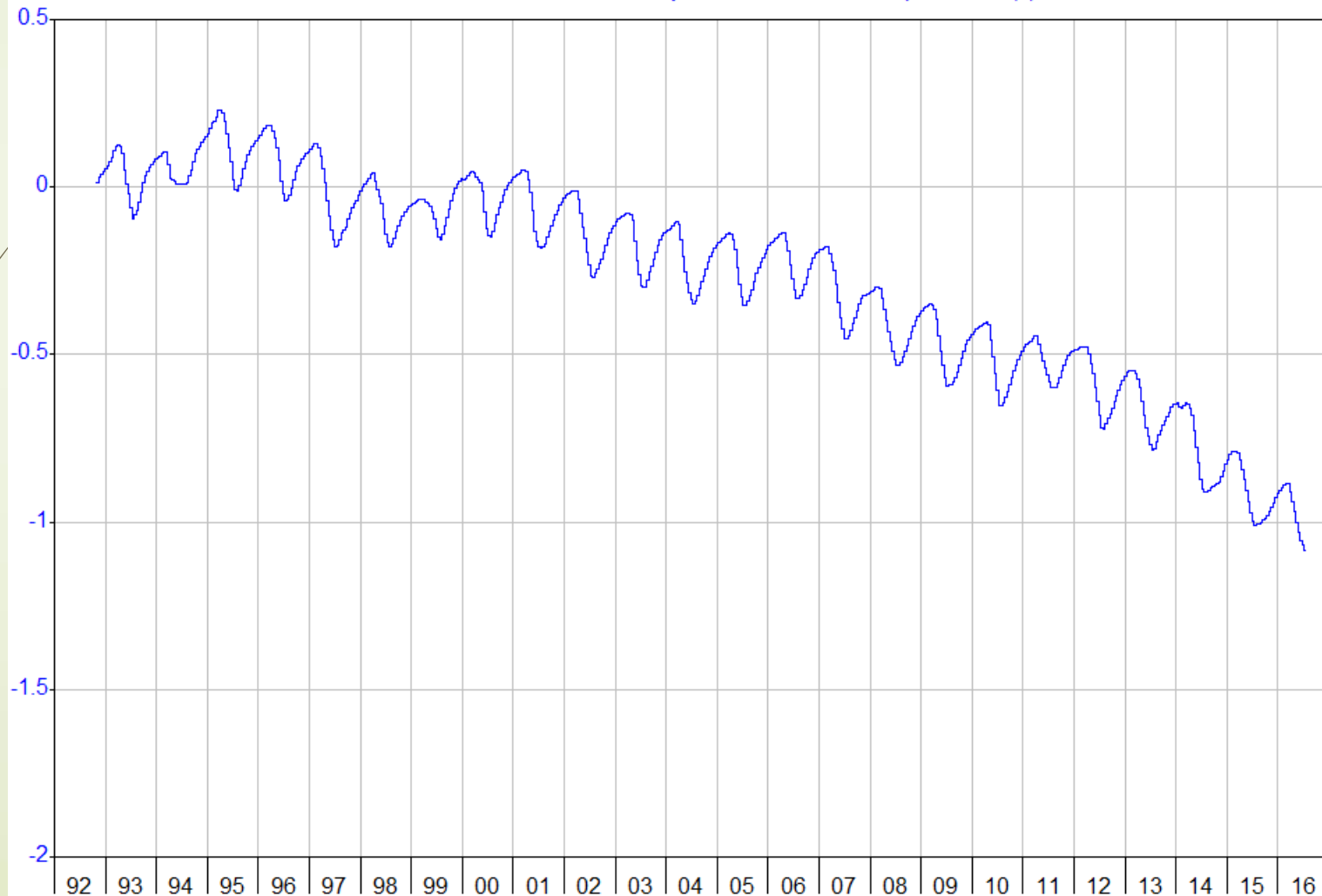
1992-2017

— 11N01E24Q008M

ZAM Ext

115.00 15 Day Mean

GS Displacement (ft)



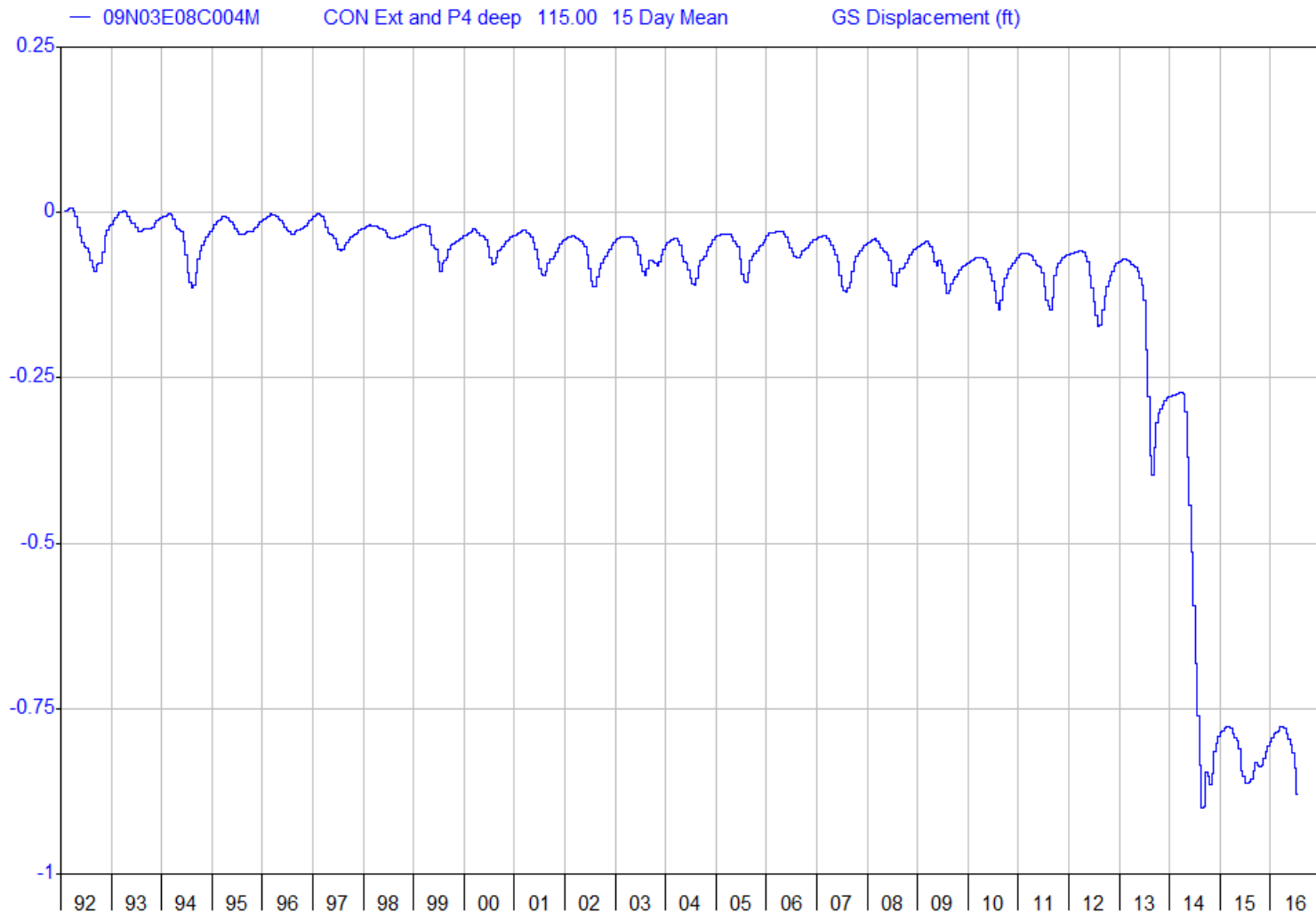
Conway Extensometer

California Department of Water Resources

HYPLOT V133 Output 08/24/2016

Period 25 Year 01/01/1992 to 01/01/2017

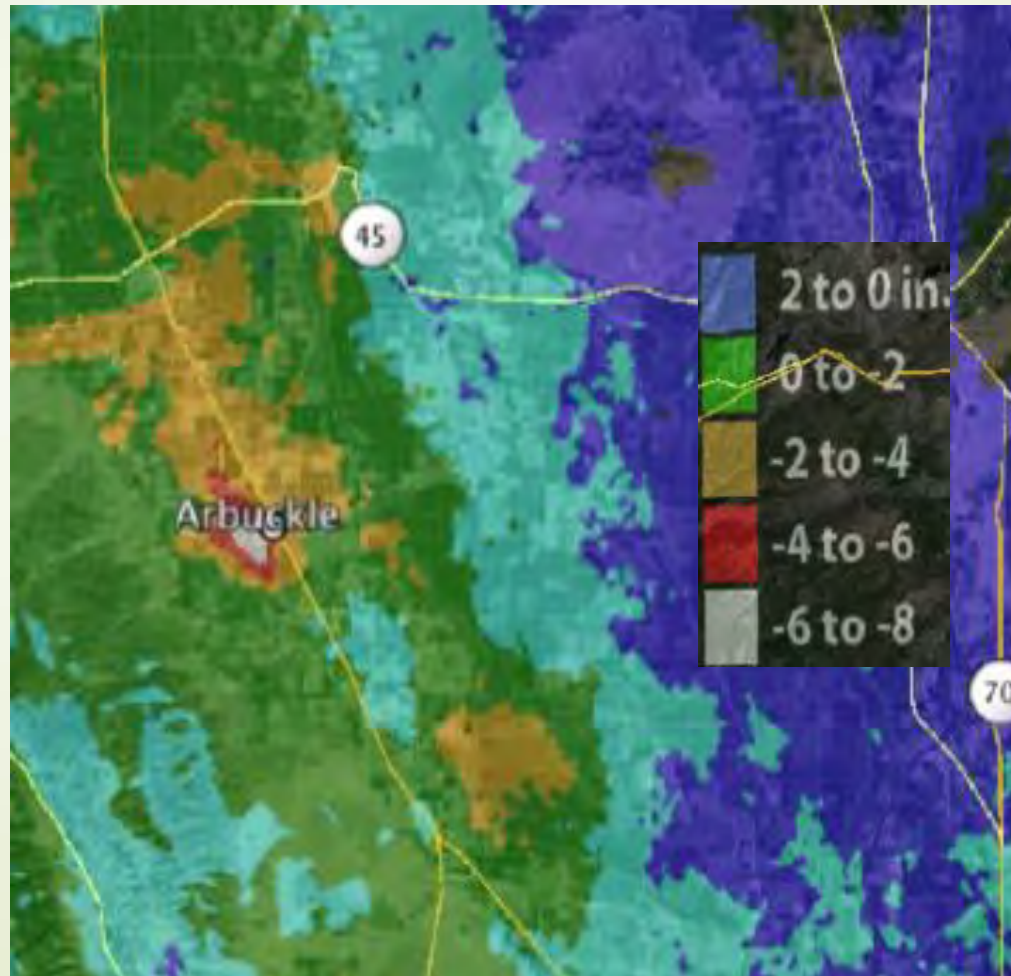
1992-2017





NASA/JPL Central Valley Remote Sensing Report (2015)

NASA/JPL Central Valley Remote Sensing Report (2015)

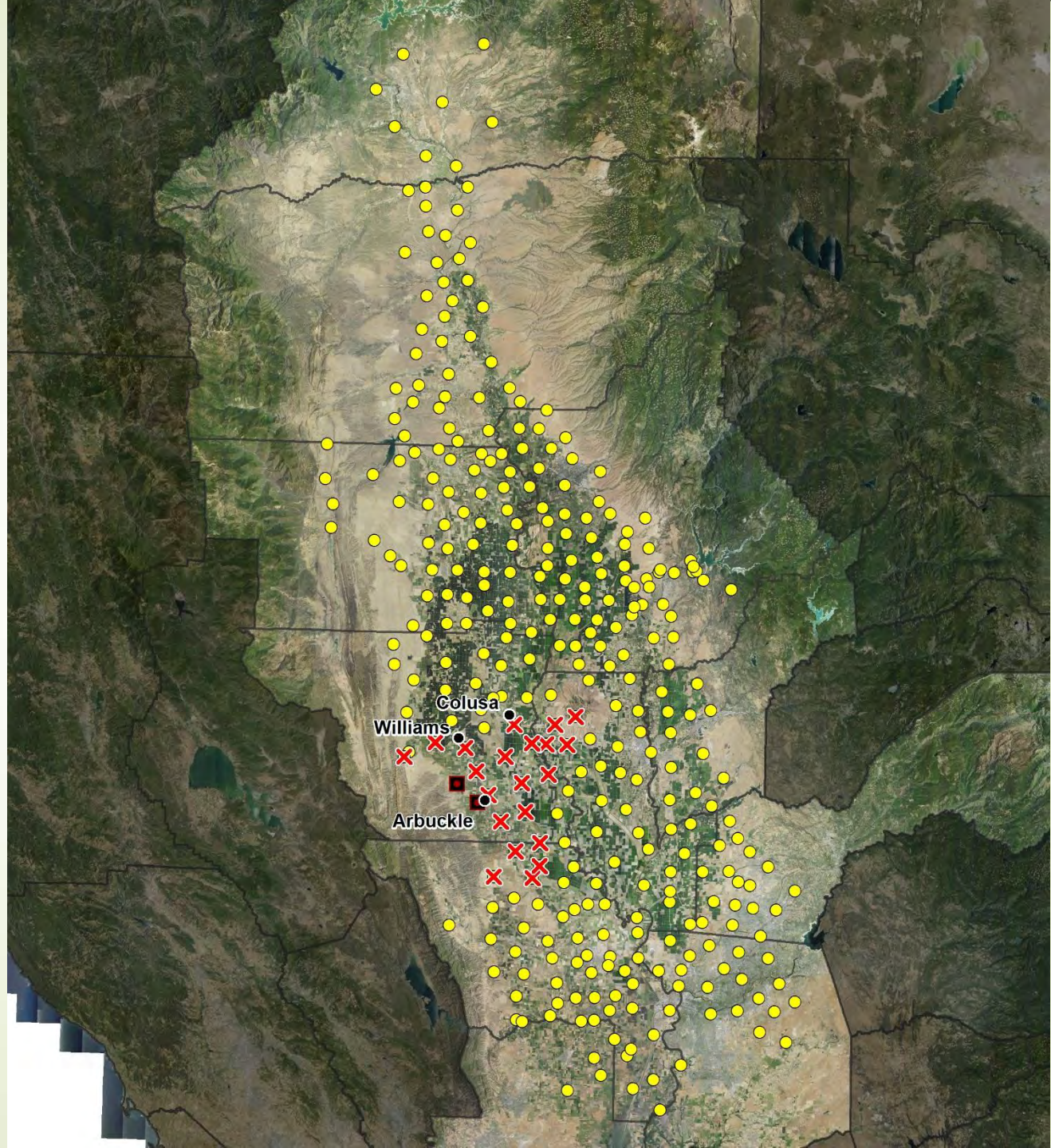


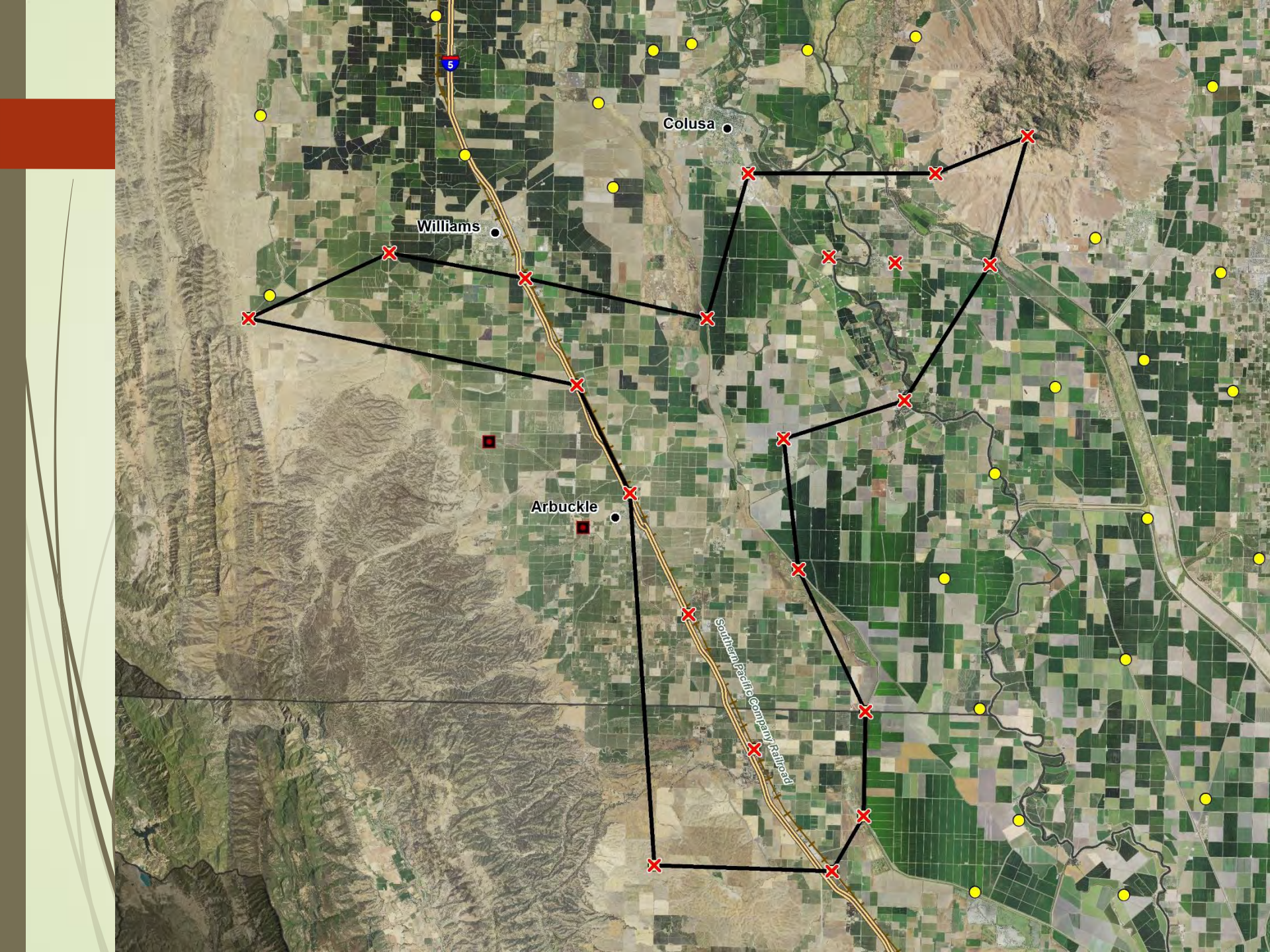
May 2014 - Jan 2015



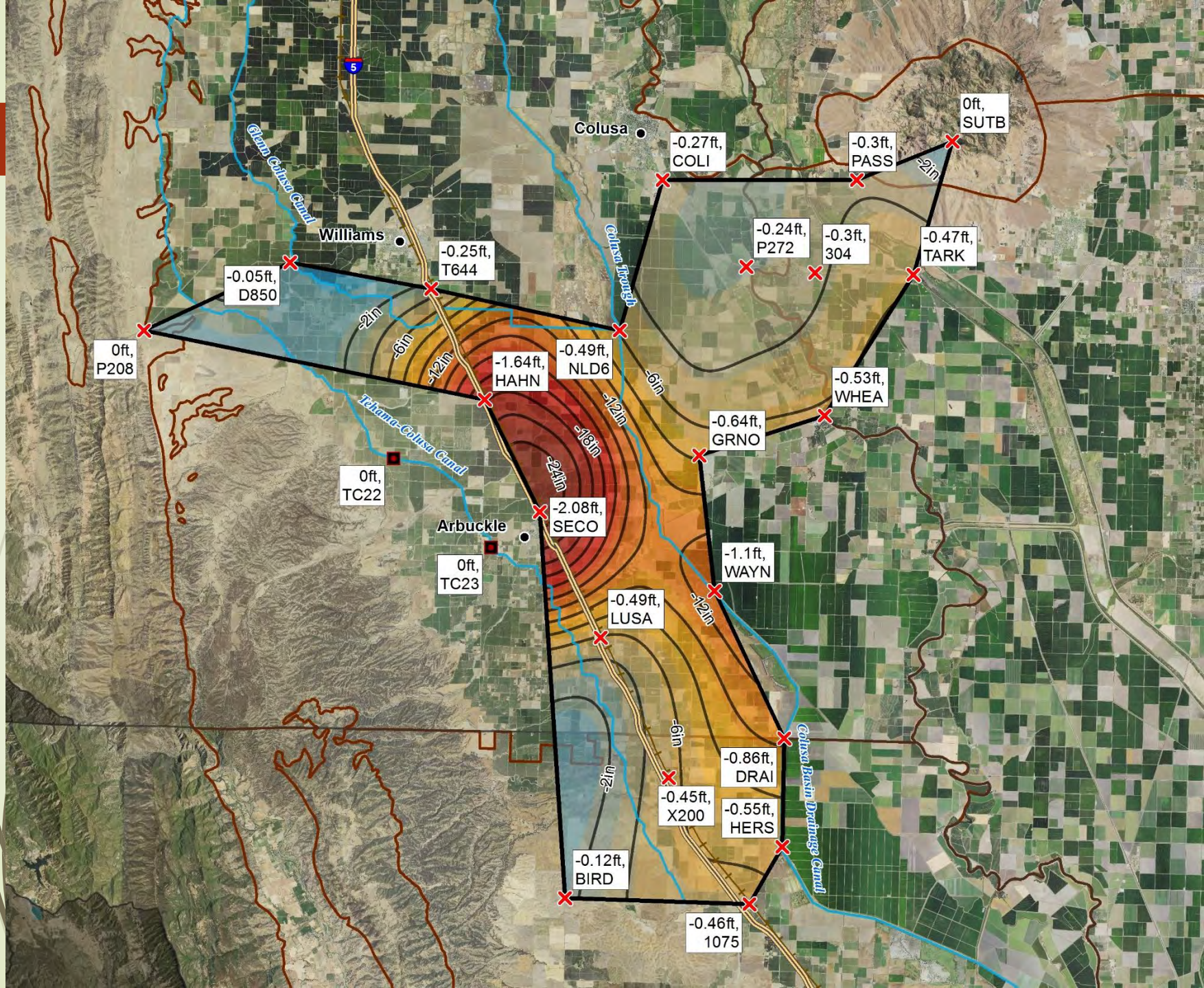
GPS Survey Results Colusa

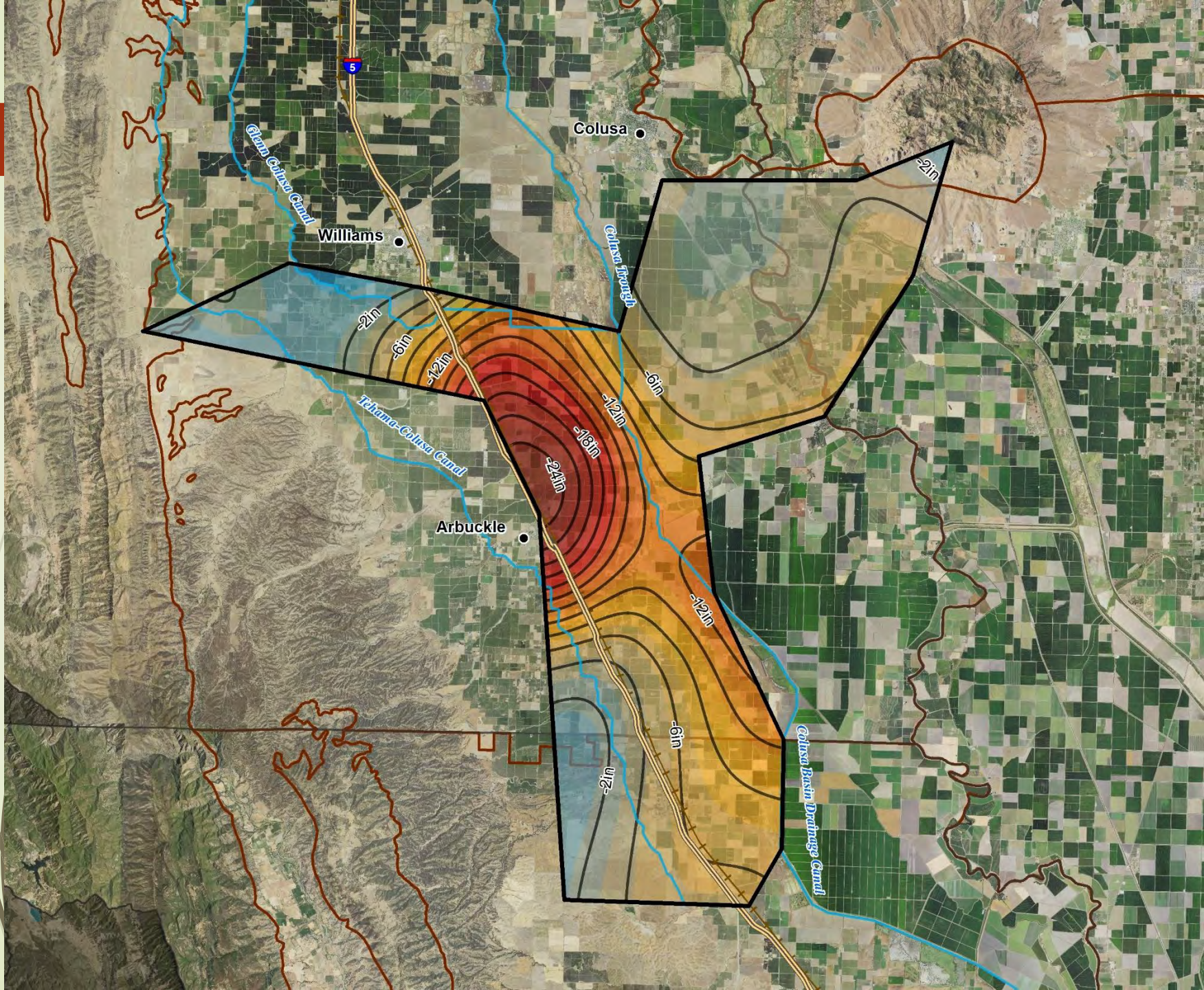
(2016)



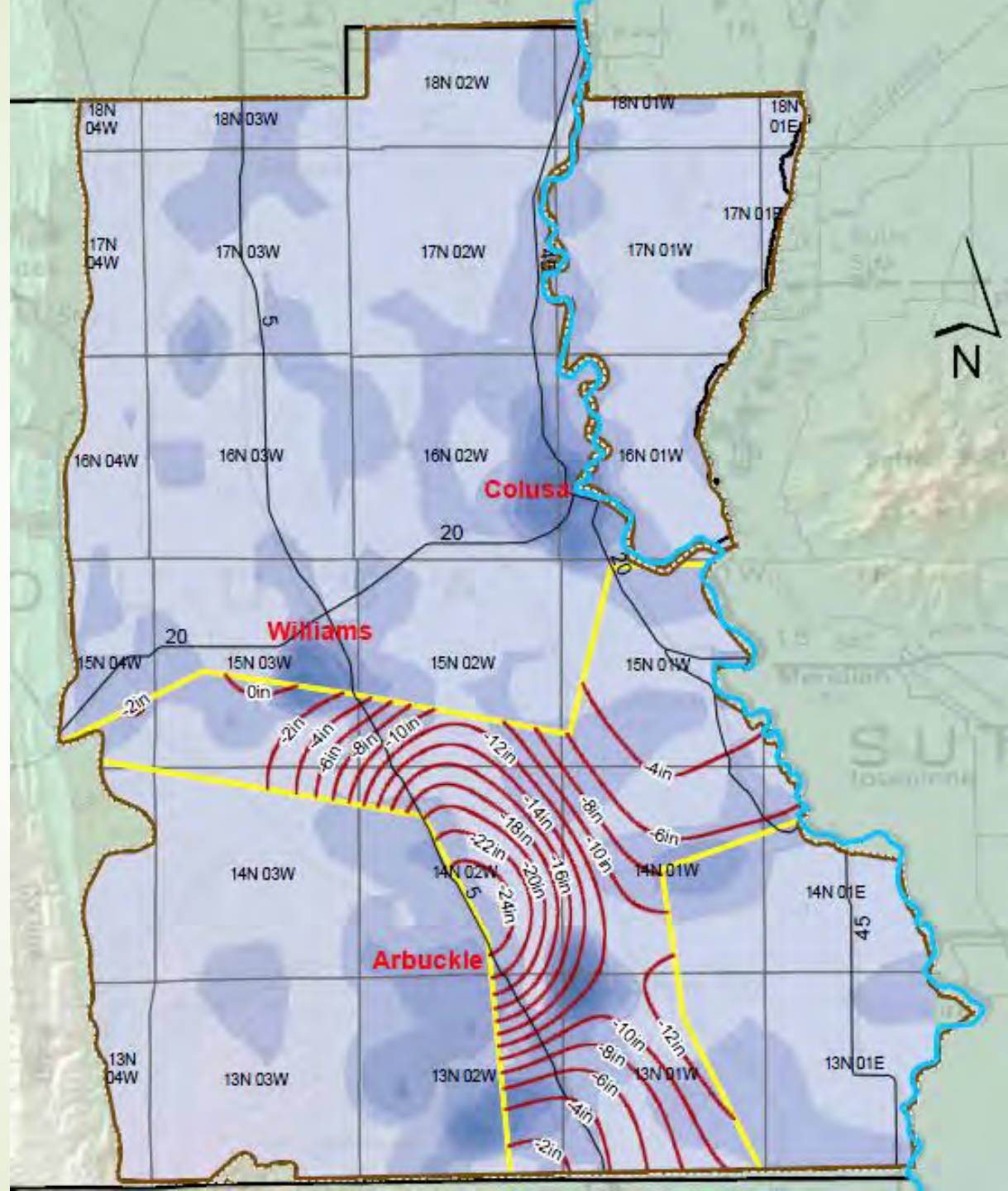




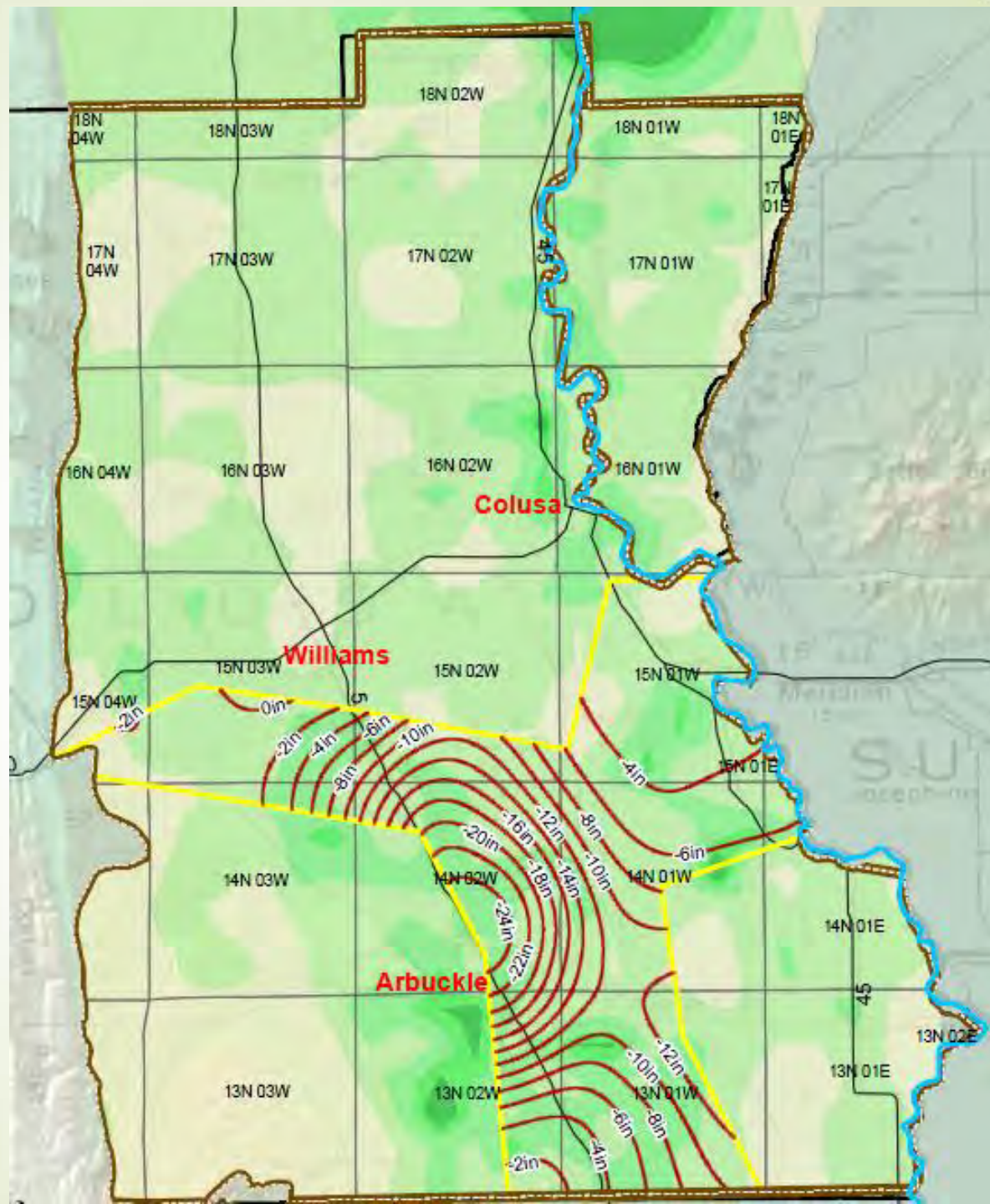




Domestic Well Density



High Production Well Density





Colusa County Conditions

Maps, hydrographs, and extensometers

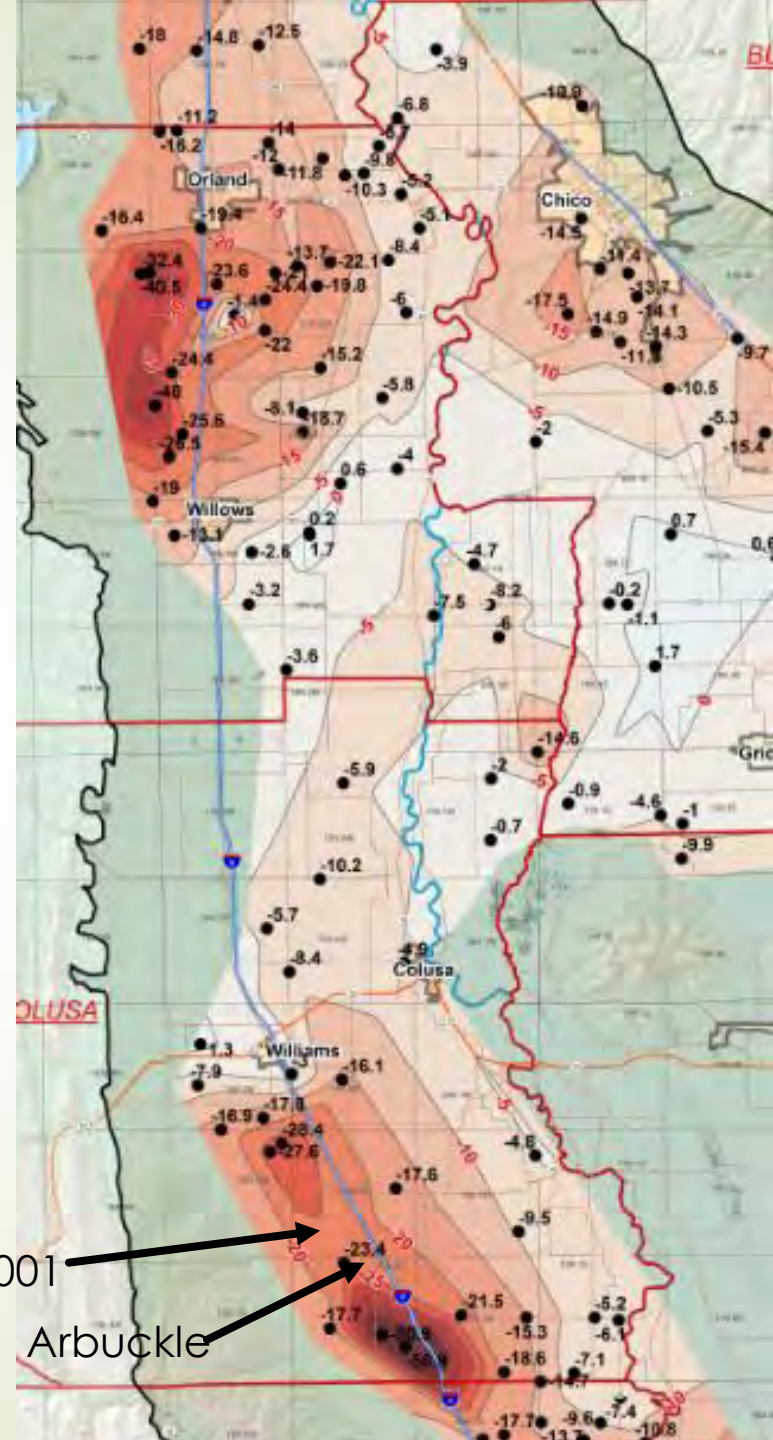
Groundwater Elevation Change Map Colusa Basin

Spring 2011 to 2016

Intermediate:
Between 200 and 600 feet
below ground surface

14N02W29J001

Arbuckle



14N02W29J001M



Delevan NWR Extensometer

California Department of Water Resources

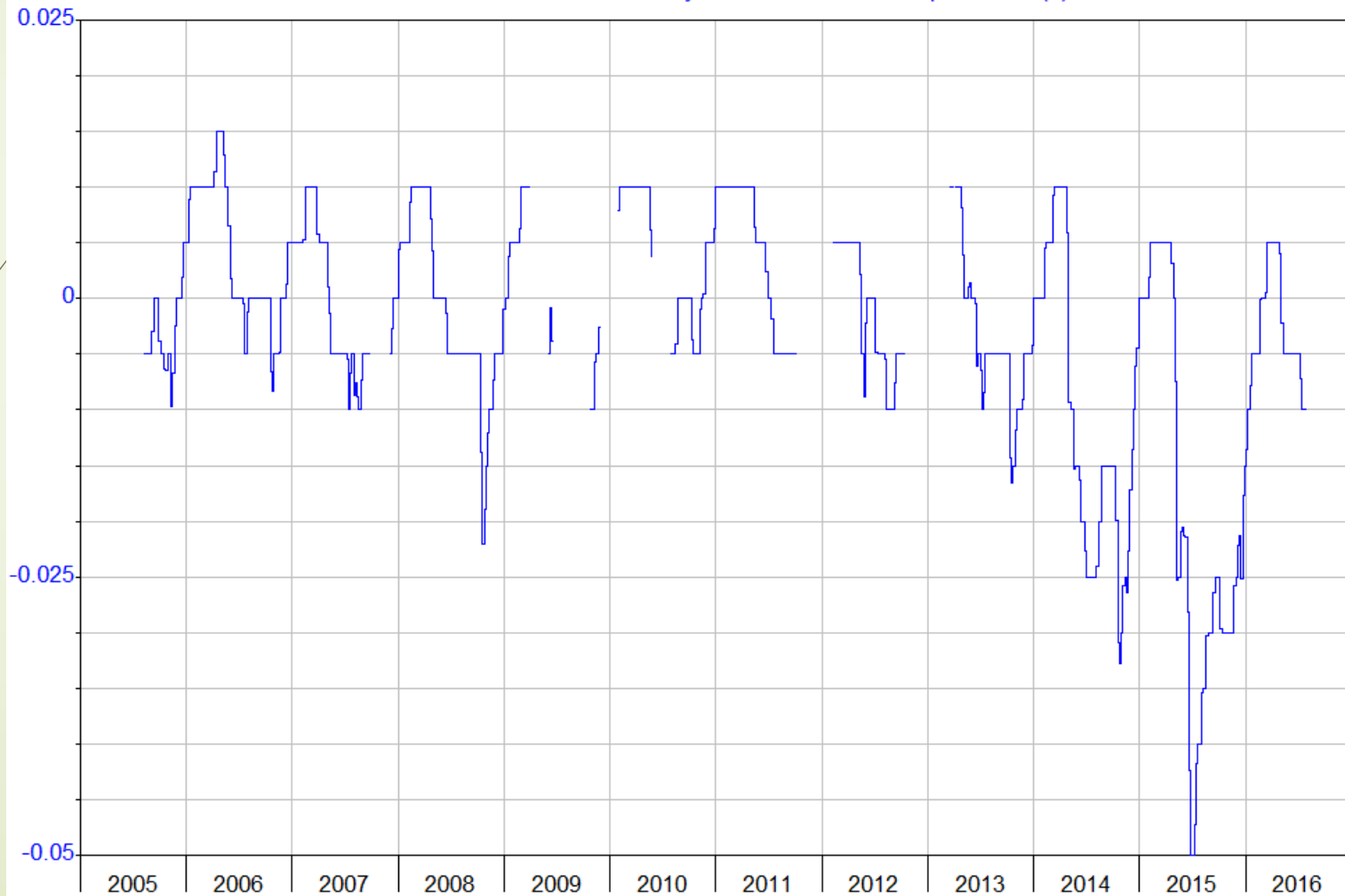
HYPLOT V133 Output 08/24/2016

Period 12 Year 01/01/2005 to 01/01/2017

2005-17

— 17N02W09H002M Screen: 779-800 ft 115.00 6 Day Mean

GS Displacement (ft)



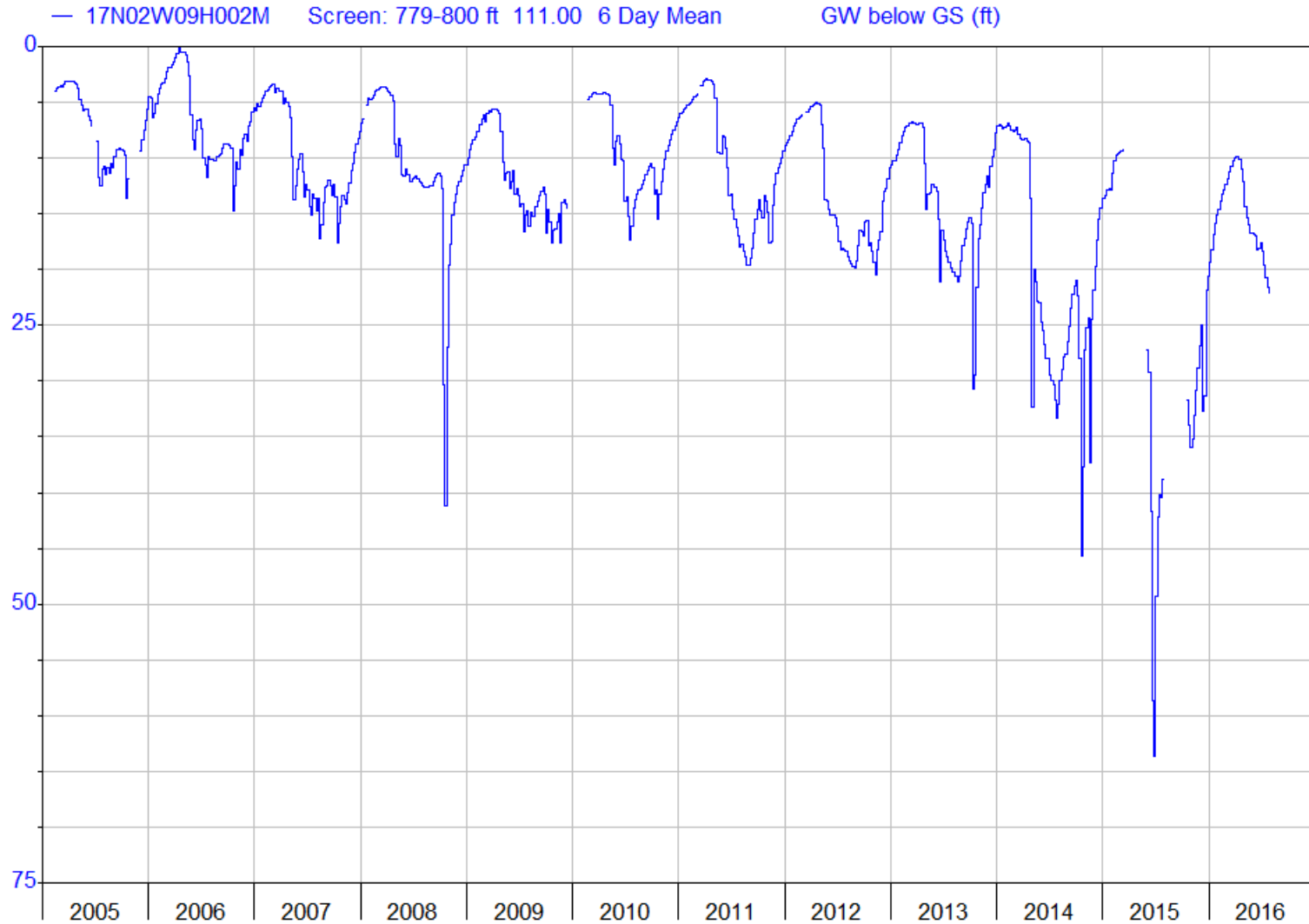
Delevan NWR Hydrograph

California Department of Water Resources

HYPLOT V133 Output 08/24/2016

Period 12 Year 01/01/2005 to 01/01/2017

2005-17



Maxwell Road Extensometer

California Department of Water Resources

HYPLOT V133 Output 08/24/2016

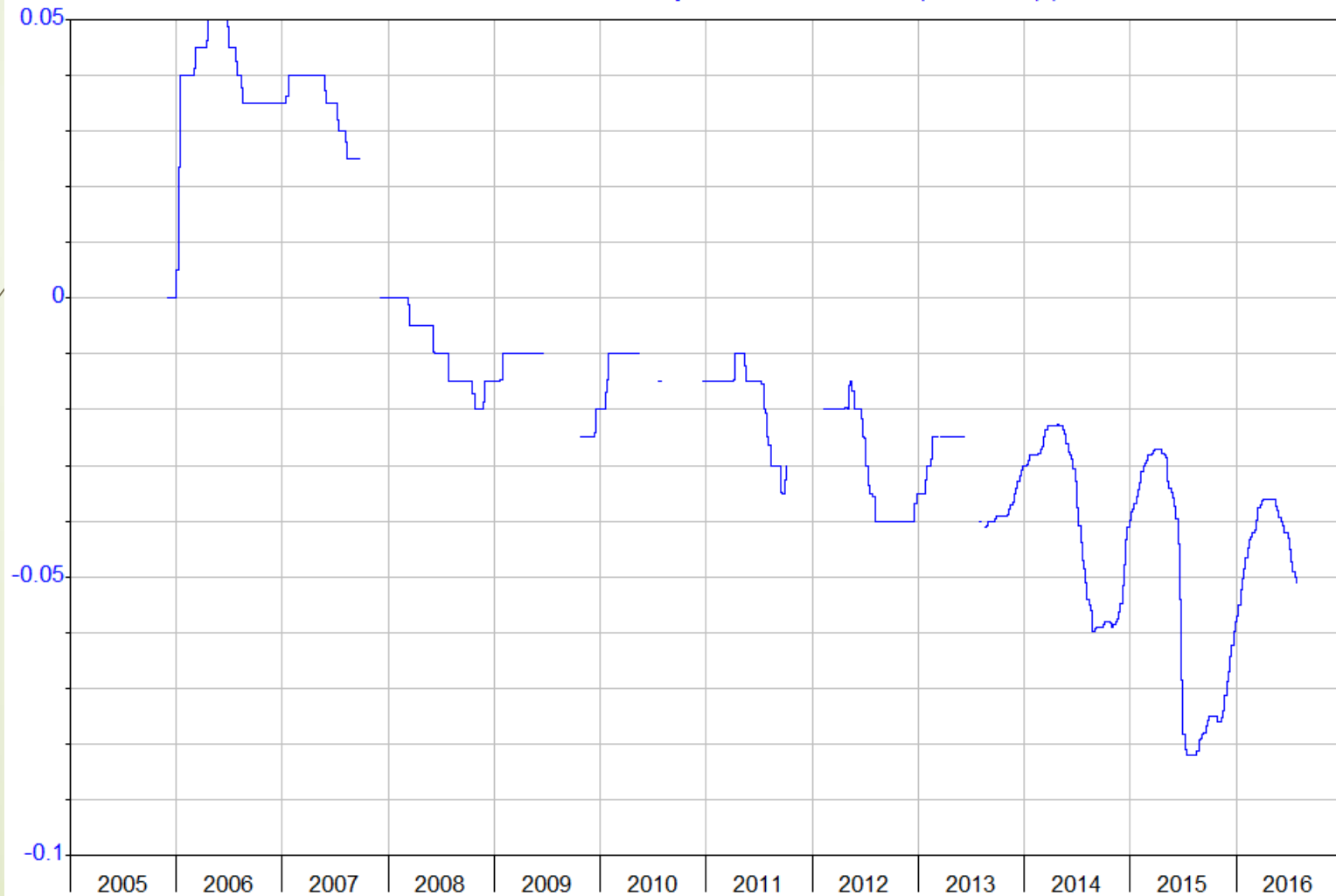
Period 12 Year 01/01/2005 to 01/01/2017

2005-17

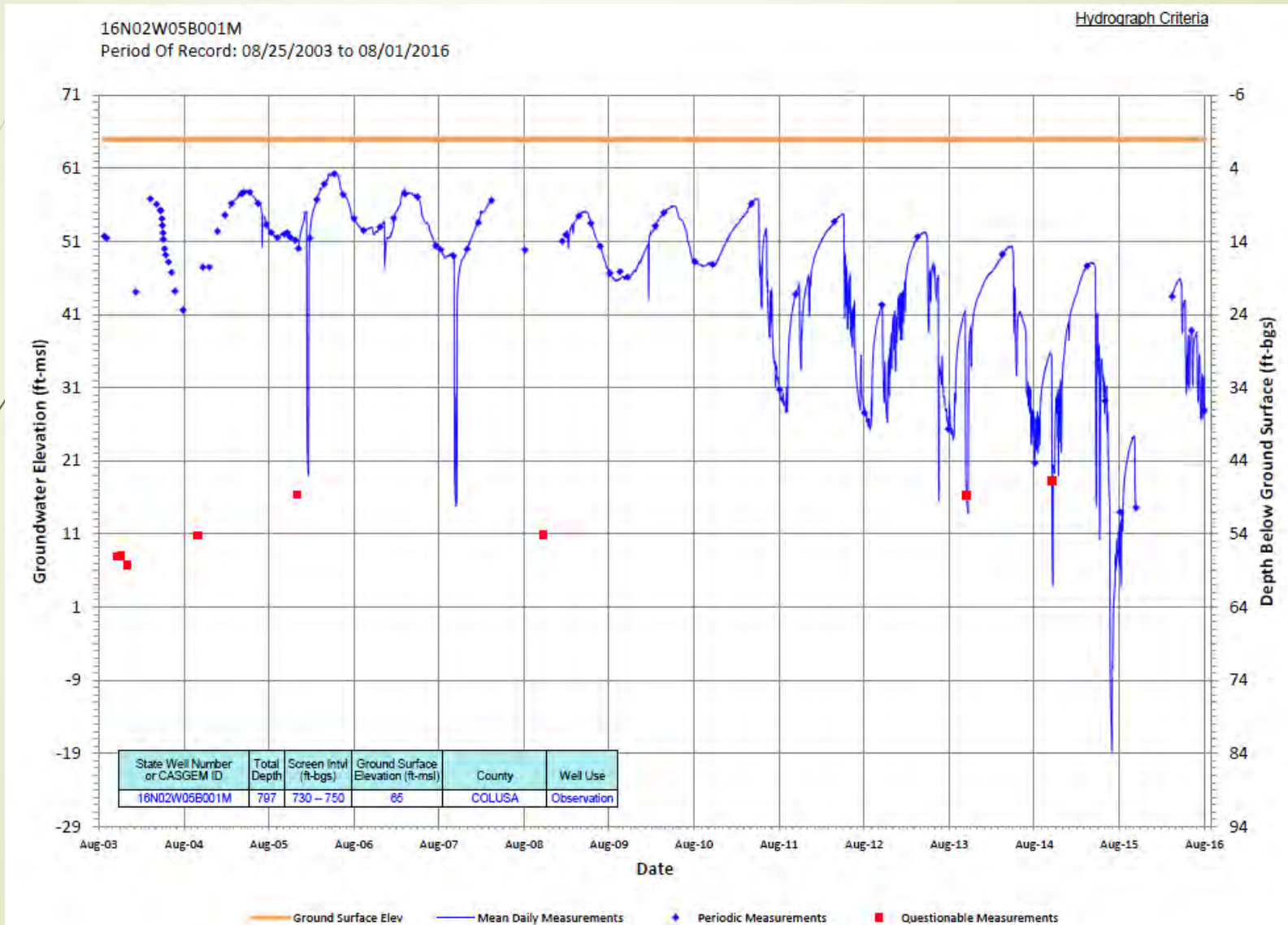
— 16N02W05B001M

Screen: 730-750 ft 115.00 6 Day Mean

GS Displacement (ft)



Maxwell Road Hydrograph





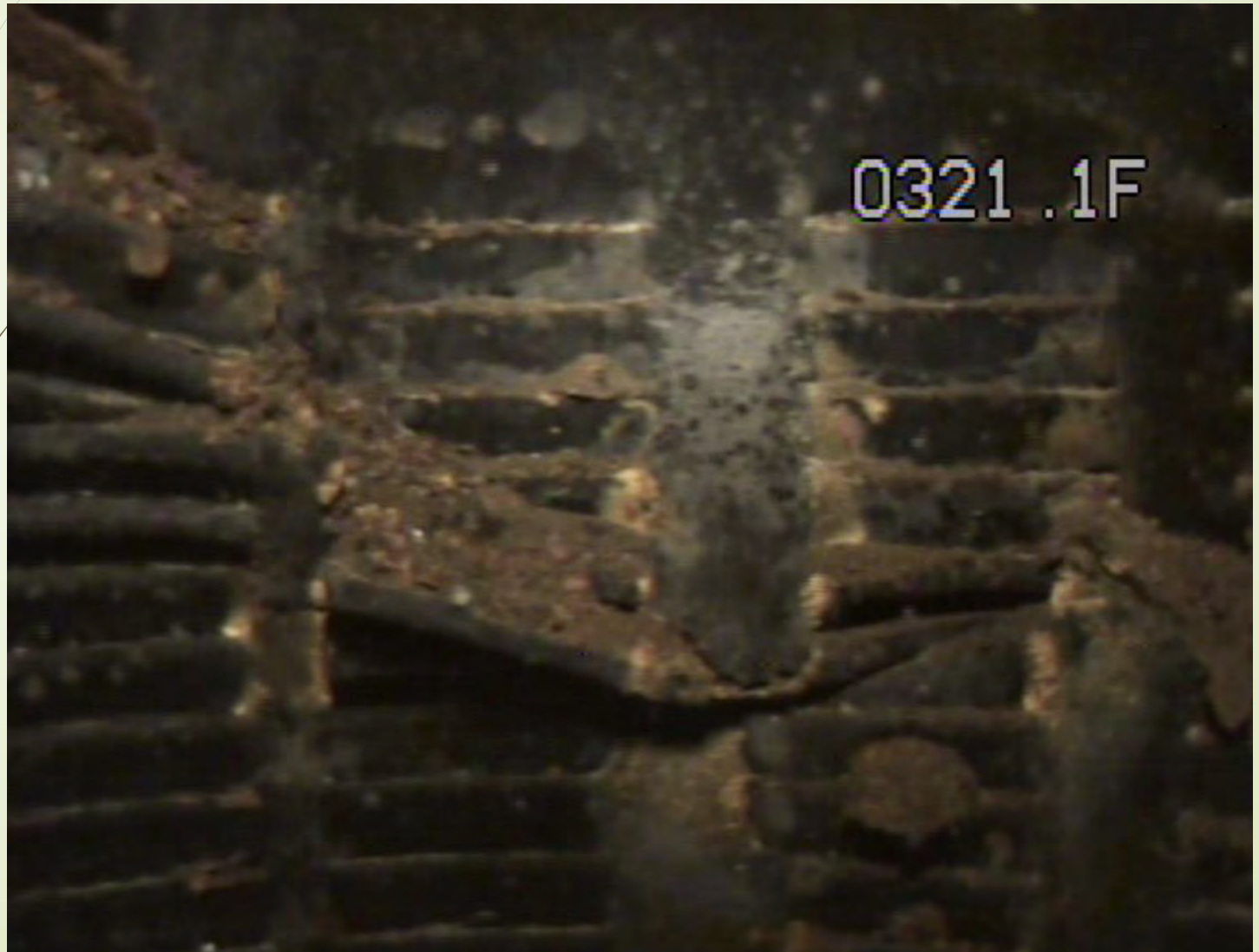
Other subsidence information & SGMA



Potential location related subsidence impacts

- Potential damage to roads, railroads, buildings, buried utilities, wells, conveyance, levies, drainage, etc.
- Received reports that MAY BE related to subsidence
 - Wells in Arbuckle area and as far away as the City of Colusa have been damaged – vertical compression
 - Foundations and walls cracked and/or separated
 - Conveyance lining cracked and buckled
 - Unusual and recent cracking in retaining walls
 - More frequent field leveling
 - Ground slumping – field drainage and roads, etc.

City of Colusa well





Arbuckle Well

Engineering Report (July 2015)

- “From the log it was determined the subject well has buckled at the joint where the upper screen section connects to the pump housing at approximately 229 feet (video depth).
- The buckling appears consistent with subsidence forces, which may be associated with the decline in water levels in the past 1 to 2 years.
- The buckling has not resulted in a failure, such as parting or tearing of the well screen.
- However, if the forces that caused the buckling are related to declining water levels, we expect that continued water level decline during the current high demand period will result in more deformation.”

Conveyance

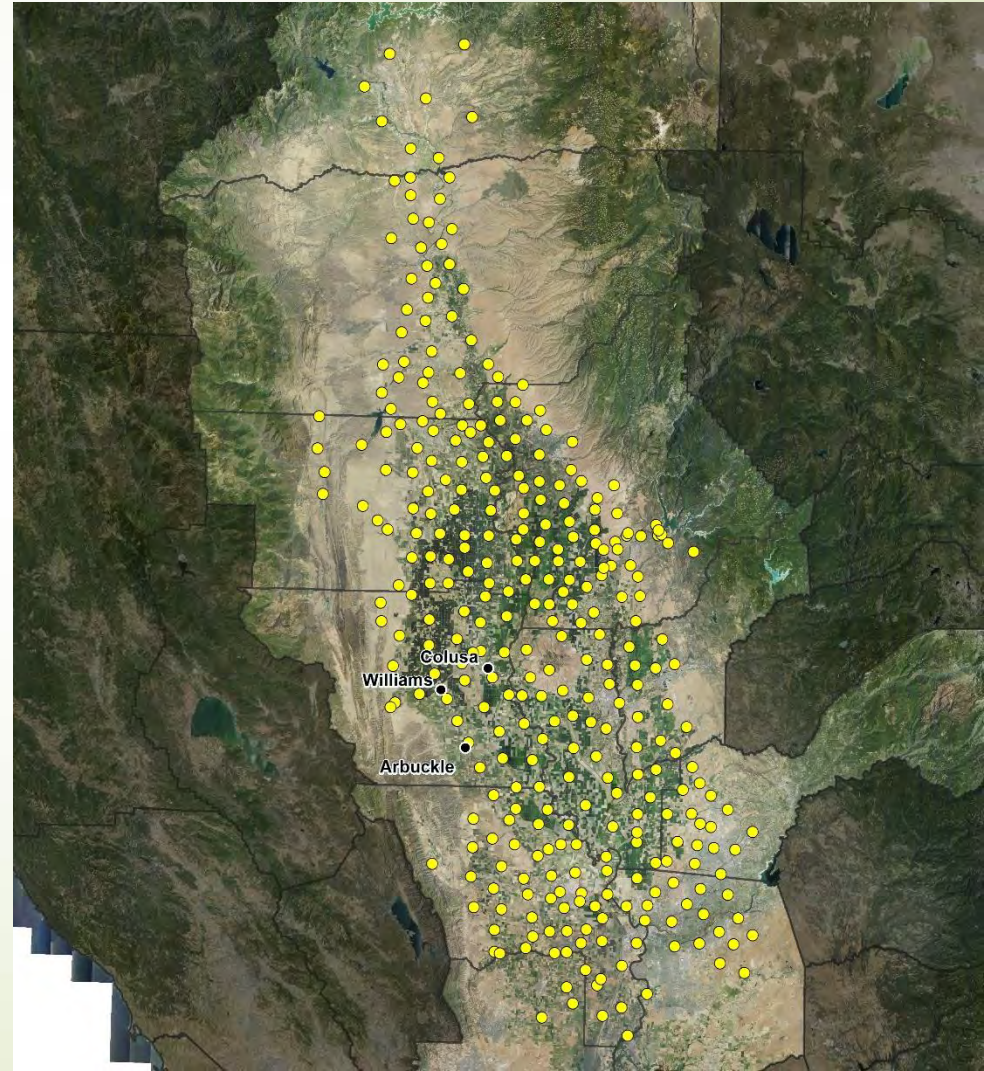


Sustainable GW Management

- Significant and unreasonable land subsidence 
 - 10721.x.5 Significant and unreasonable land subsidence that substantially interferes with surface land uses.
- Significant and unreasonable reduction of groundwater storage 
- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply 

Pending GPS Survey – Sacramento River Valley (Spring 2017)

- Entire Valley will be resurveyed
 - Compared back to 2008
 - Shorter duration comparisons where applicable
- Survey must be done in the Spring
- Coordination with each county will begin this Fall



Thank you!
Questions?



Photo Credit: Sue Graue

<http://water.ca.gov/groundwater/>