# Napa County Groundwater Sustainability Annual Report and Other Updates

*July 26, 2018*

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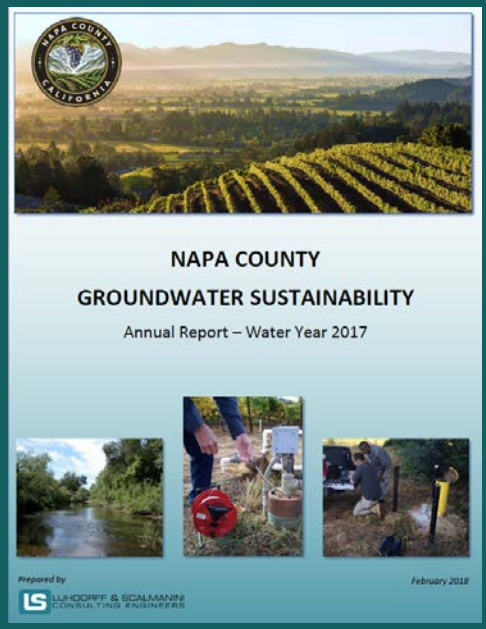
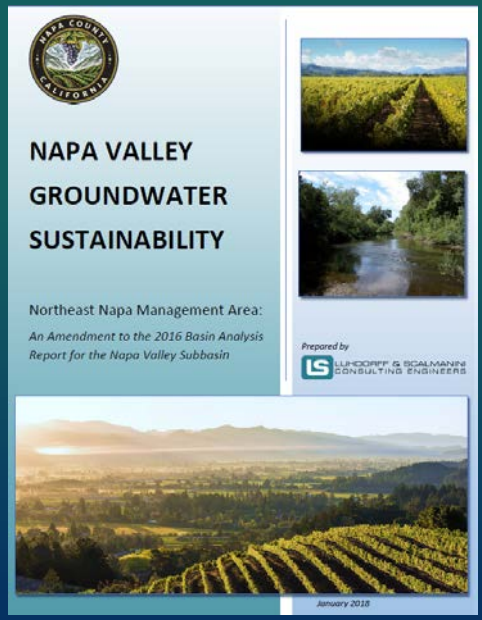
Consulting Engineers

# Overview

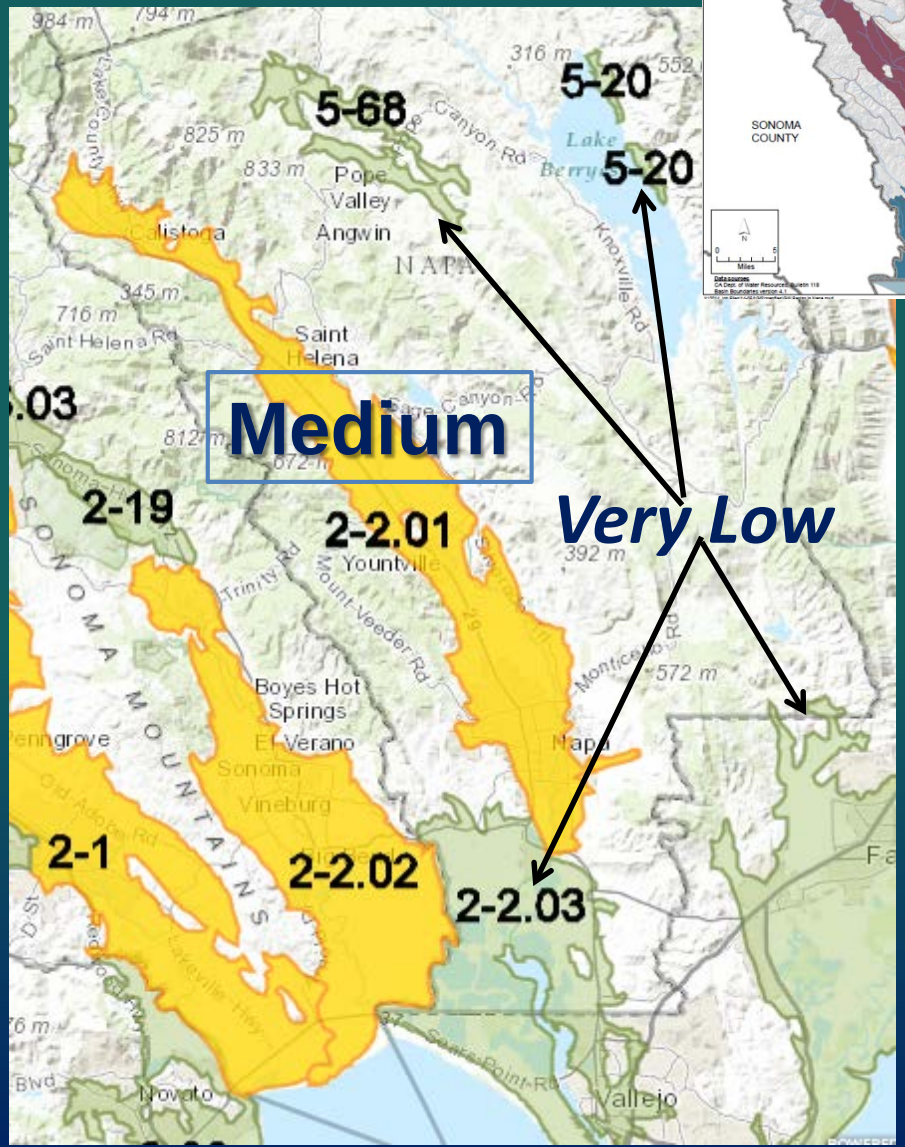
- 2017 Annual Report Highlights
- SGMA Implementation Progress
- Draft Basin Prioritization
- Napa Earthquake Paper

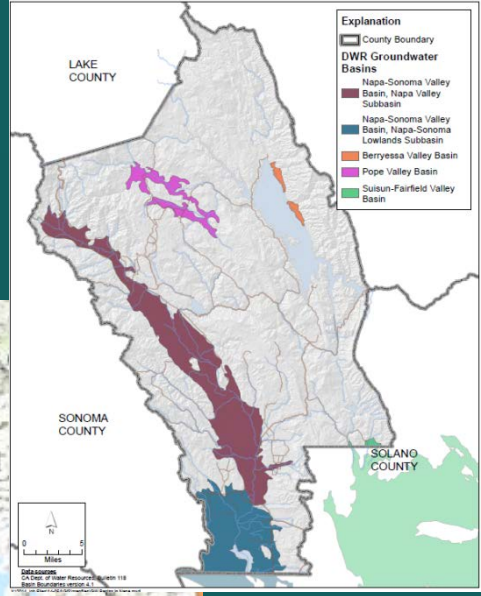


# Groundwater Basins: SGMA Prioritization

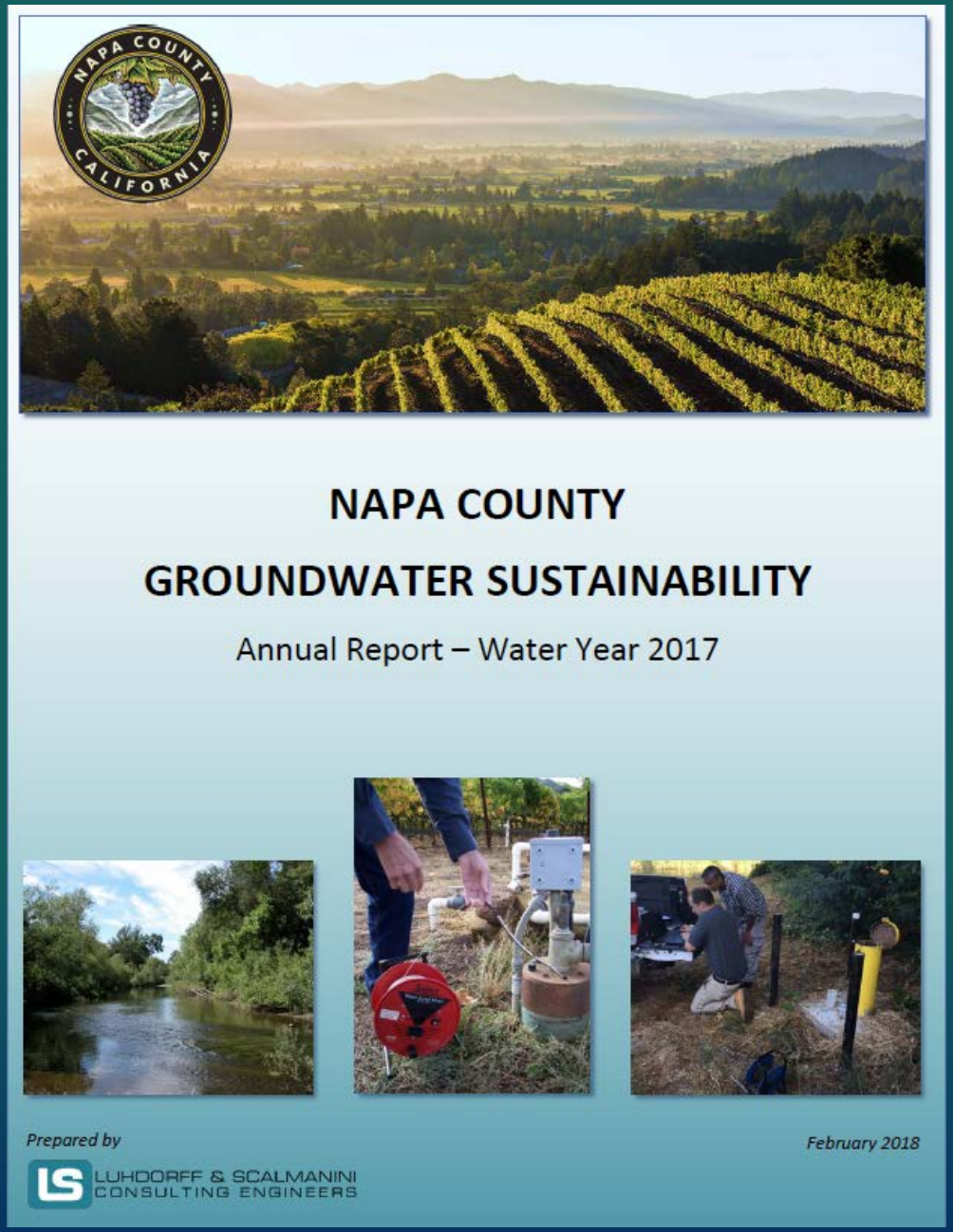
- Napa Sonoma Valley Basin
  - **Napa Valley Subbasin (Med)**
  - Napa-Sonoma Lowlands Subbasin (VL)
- Berryessa Valley Basin (VL)
- Pope Valley Basin (VL)
- Suisun-Fairfield Valley Basin (VL)



# GROUNDWATER CONDITIONS: Highlights Annual Report Water Year 2017

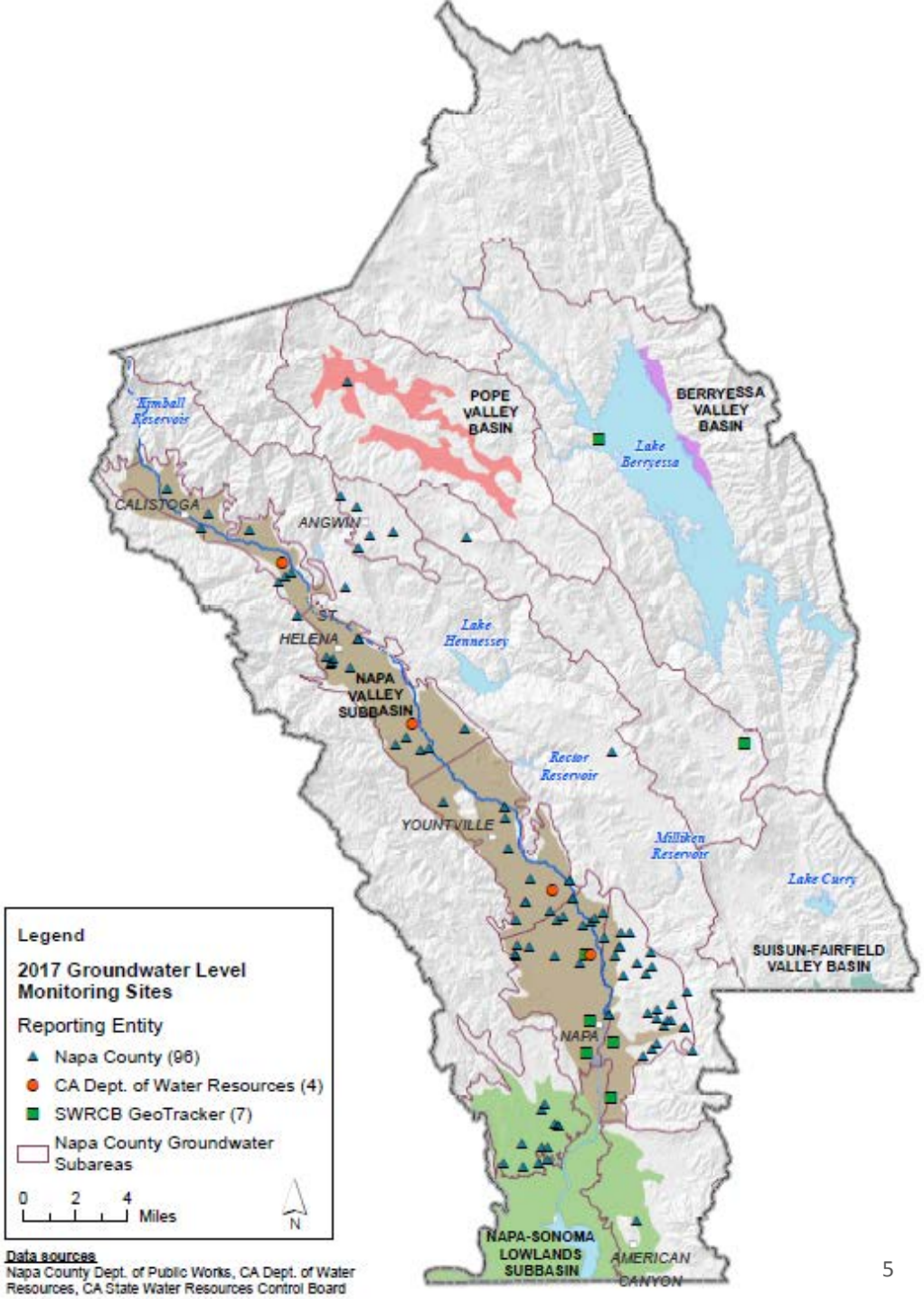
- **SGMA sustainability metrics used in Napa County 2016 Annual Report**
- **April 1, 2018: First Annual Report due for SGMA**



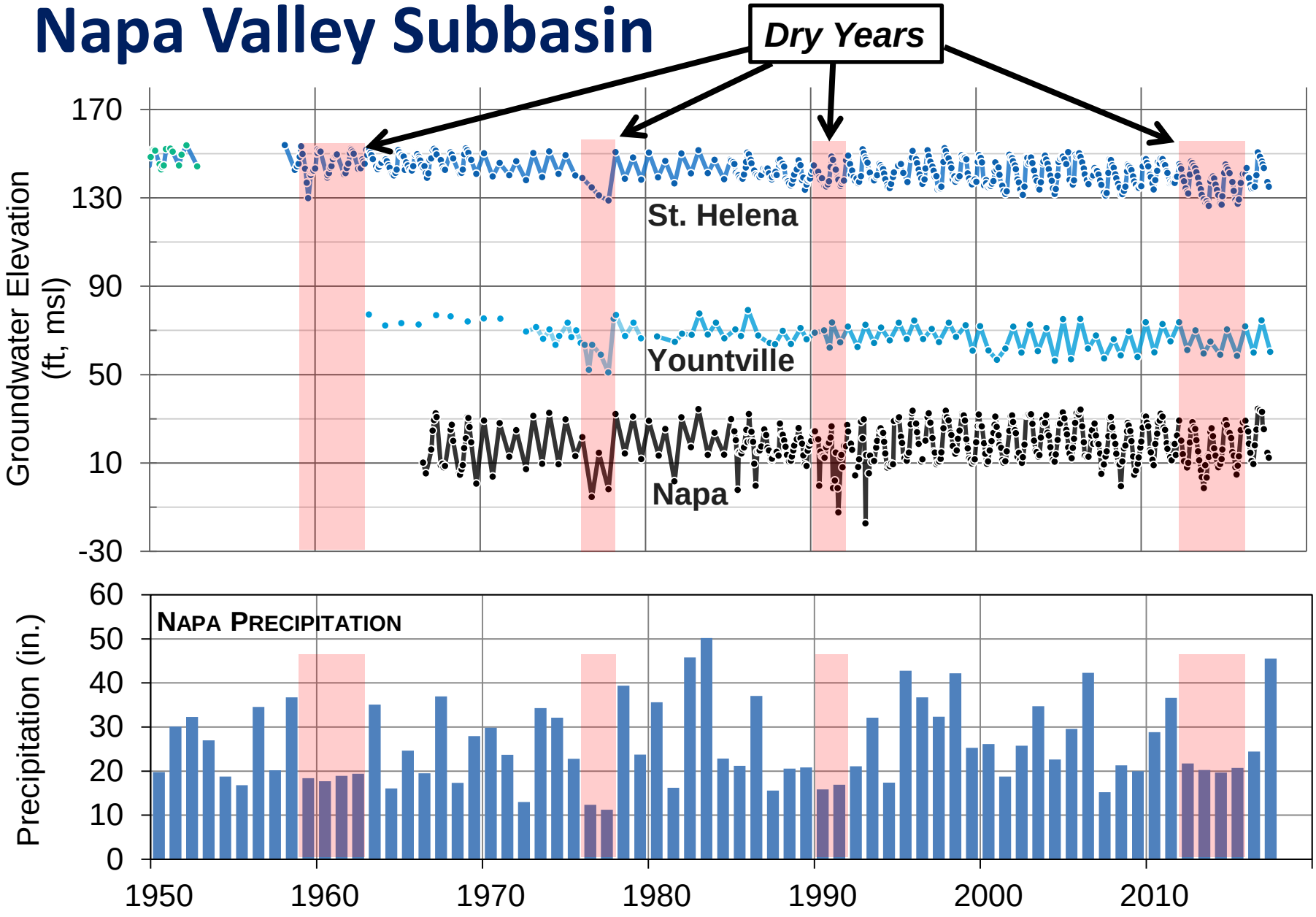
# GW Level Monitoring, 2017

- Napa Co., 96 (including 10 SW/GW)
- DWR, 4
- GeoTracker, 7

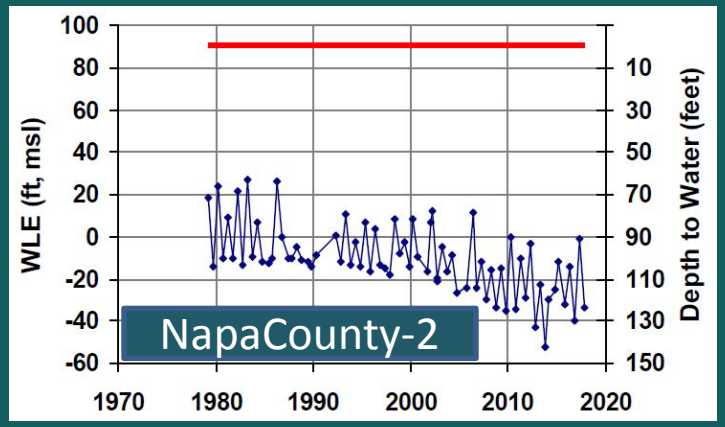
**Total Wells = 107 Sites**

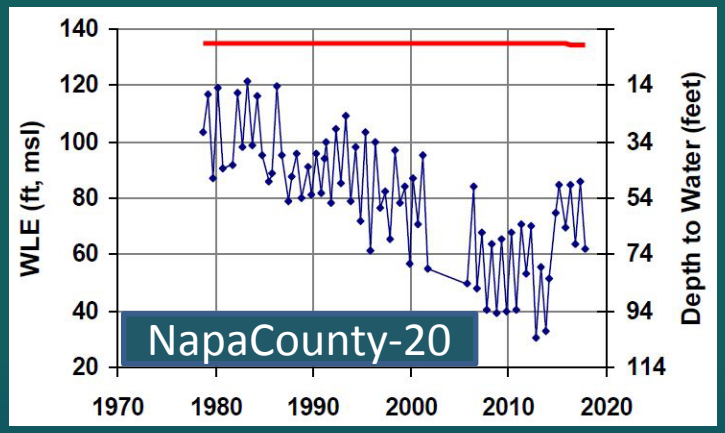


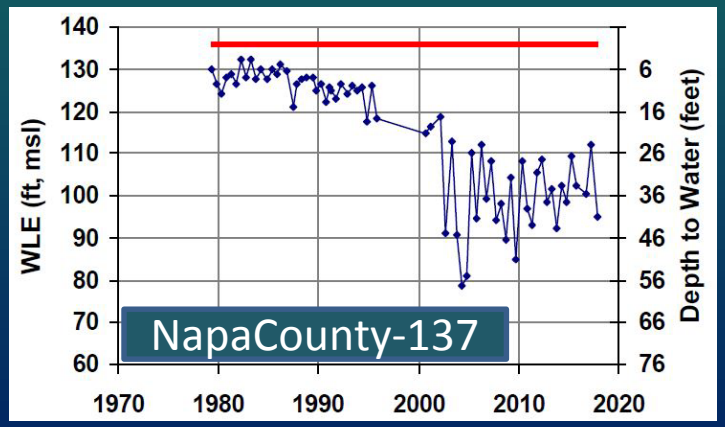
# Groundwater Conditions: Napa Valley Subbasin

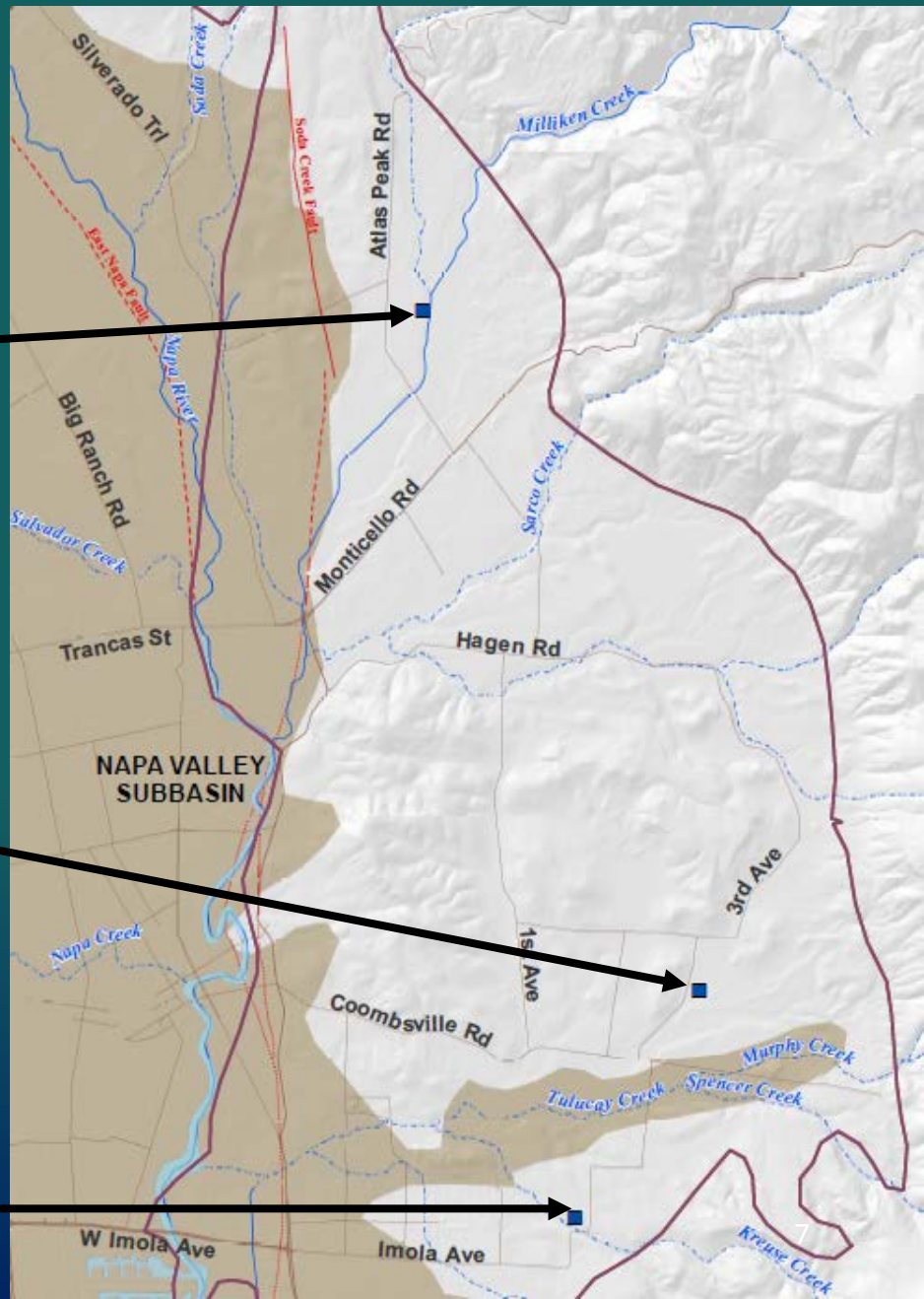


# MST Hydrographs



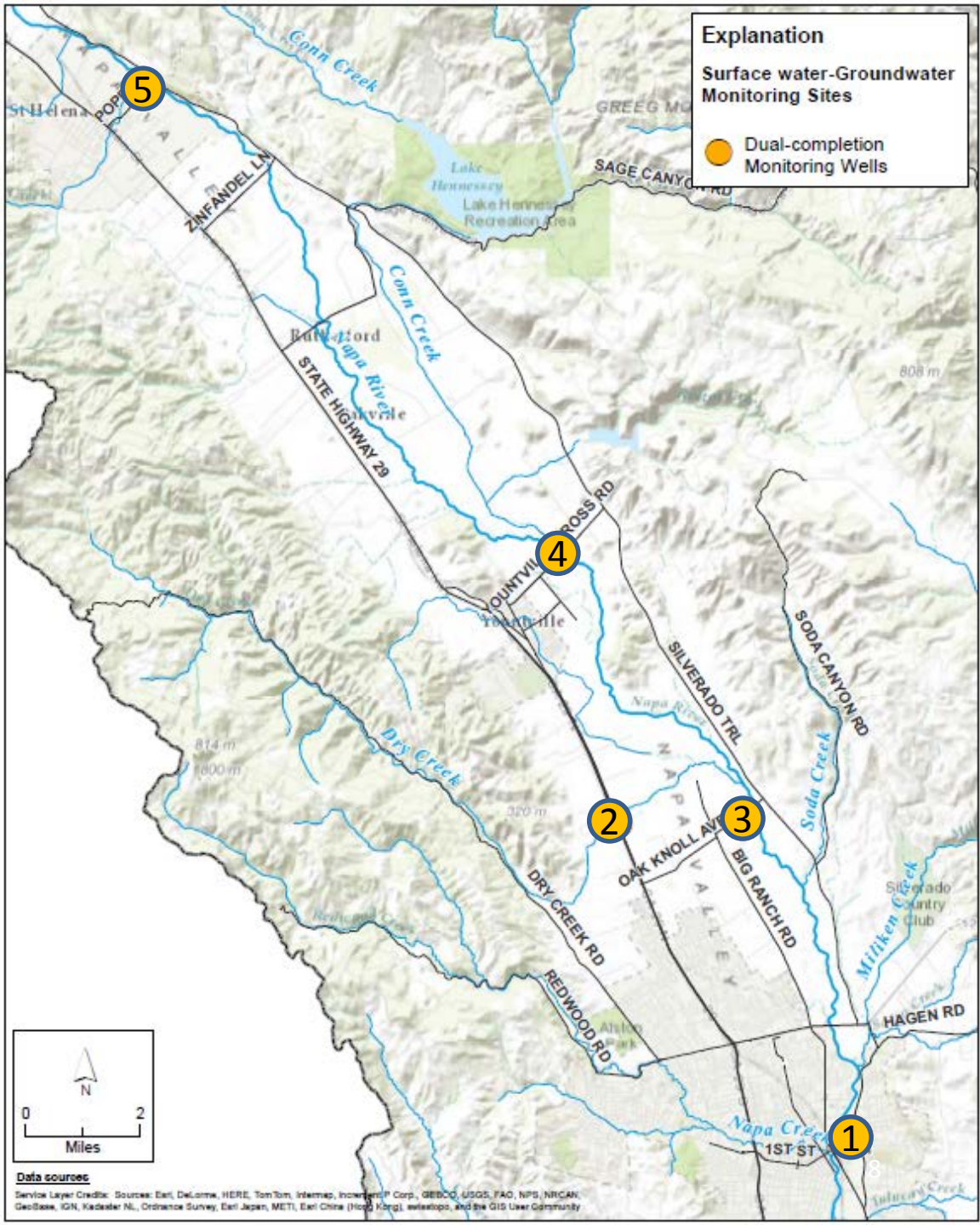



# Surface Water/ Groundwater

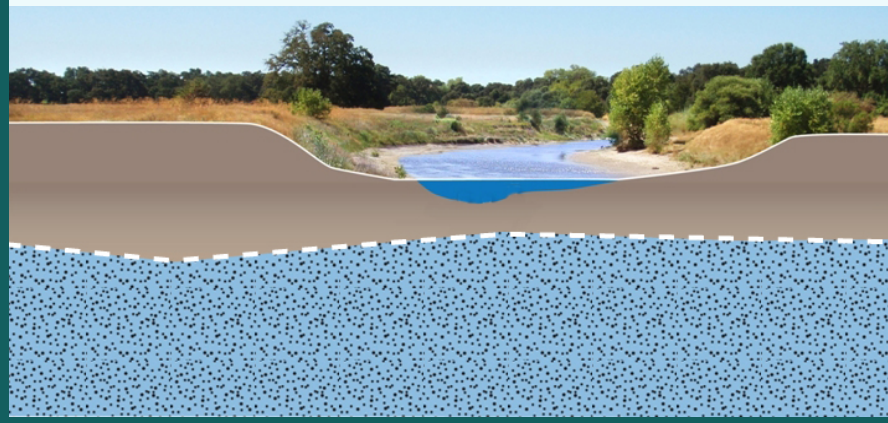
## Monitoring at 5 Sites

- Shallow Monitoring Wells (MWs) each site
  - Levels & quality
- Stream gauge each site
  - Streamflow & quality

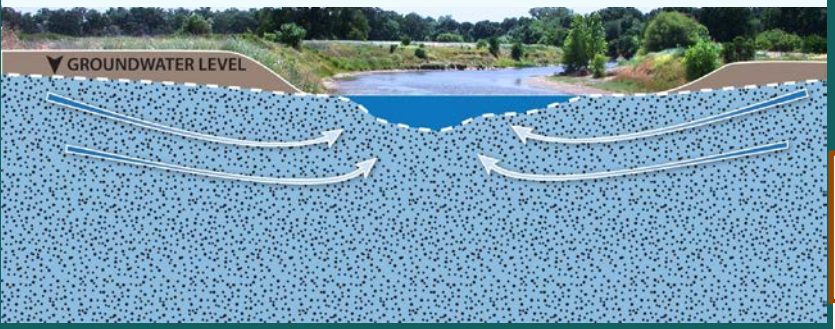


# SW/GW Interaction

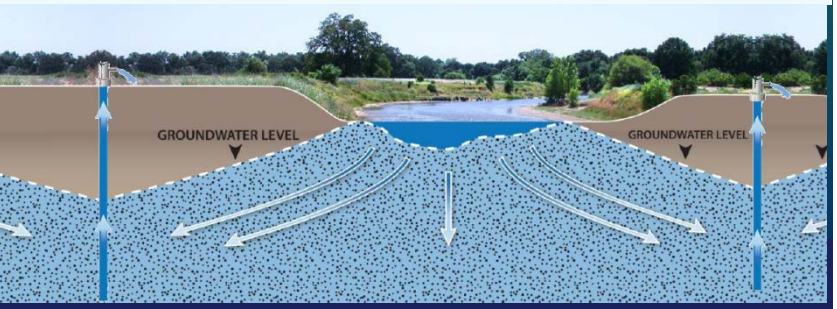
## Indirect Connection
## Stream Seepage Independent of GW Levels



## Direct Connection
## Maintains/Discharges to Stream (Groundwater Baseflow)

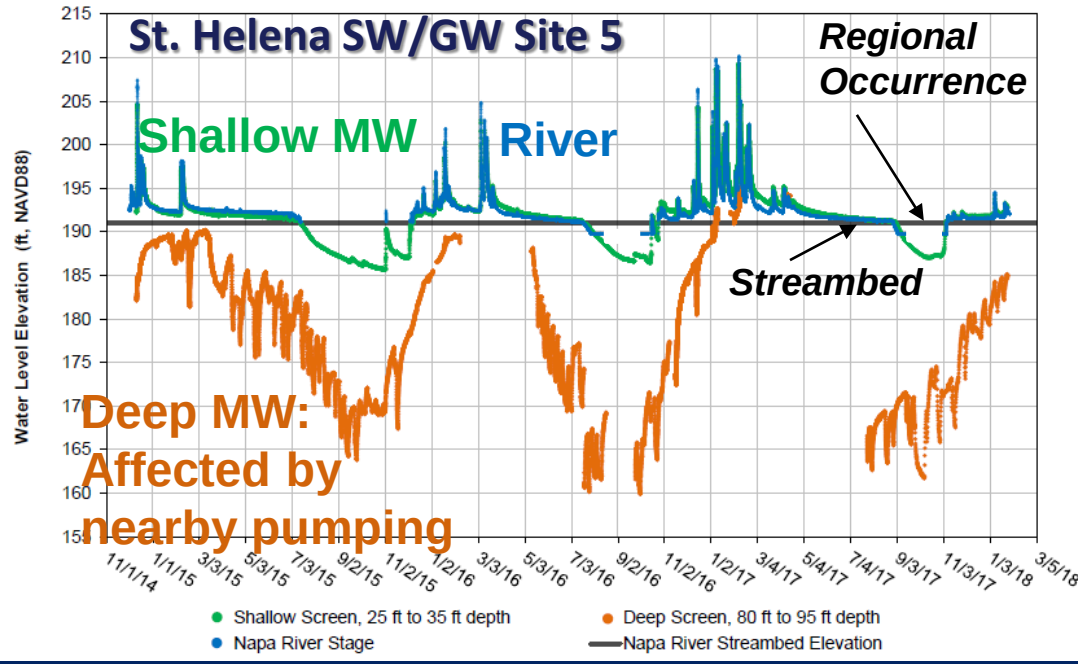



## Groundwater Pumping
## Stream Loses Water/ Recharge to GW

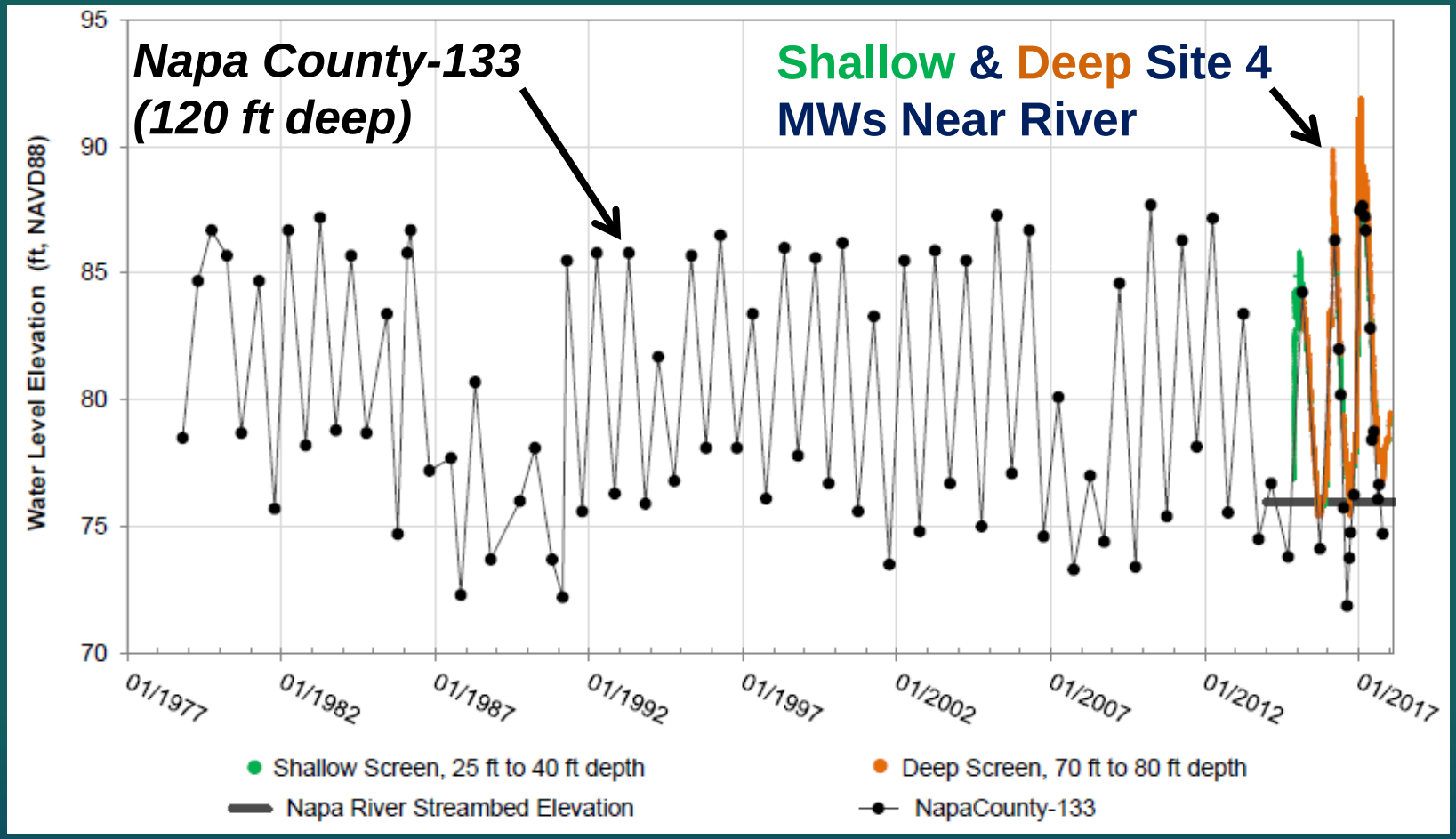


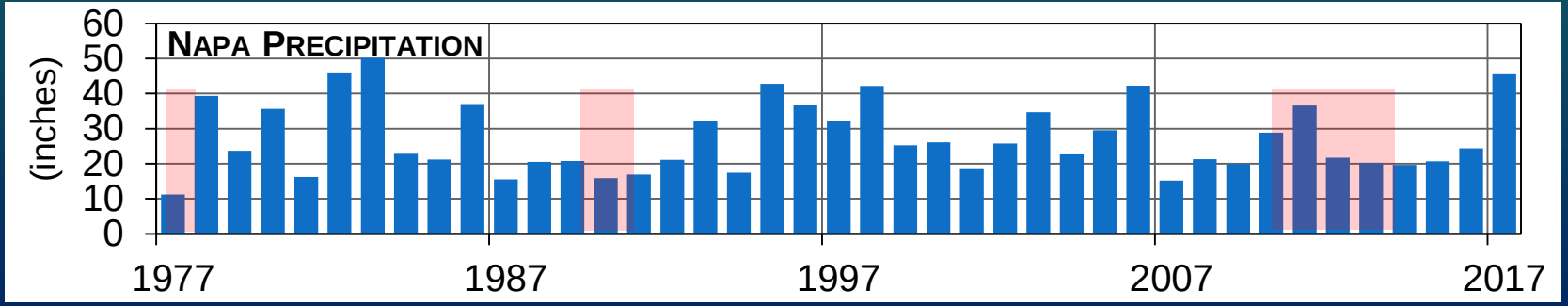

*Courtesy TNC*

River and Shallow MW not exhibiting short- term pumping effects



# SW/GW Site 4 Compared to Historical GW Levels



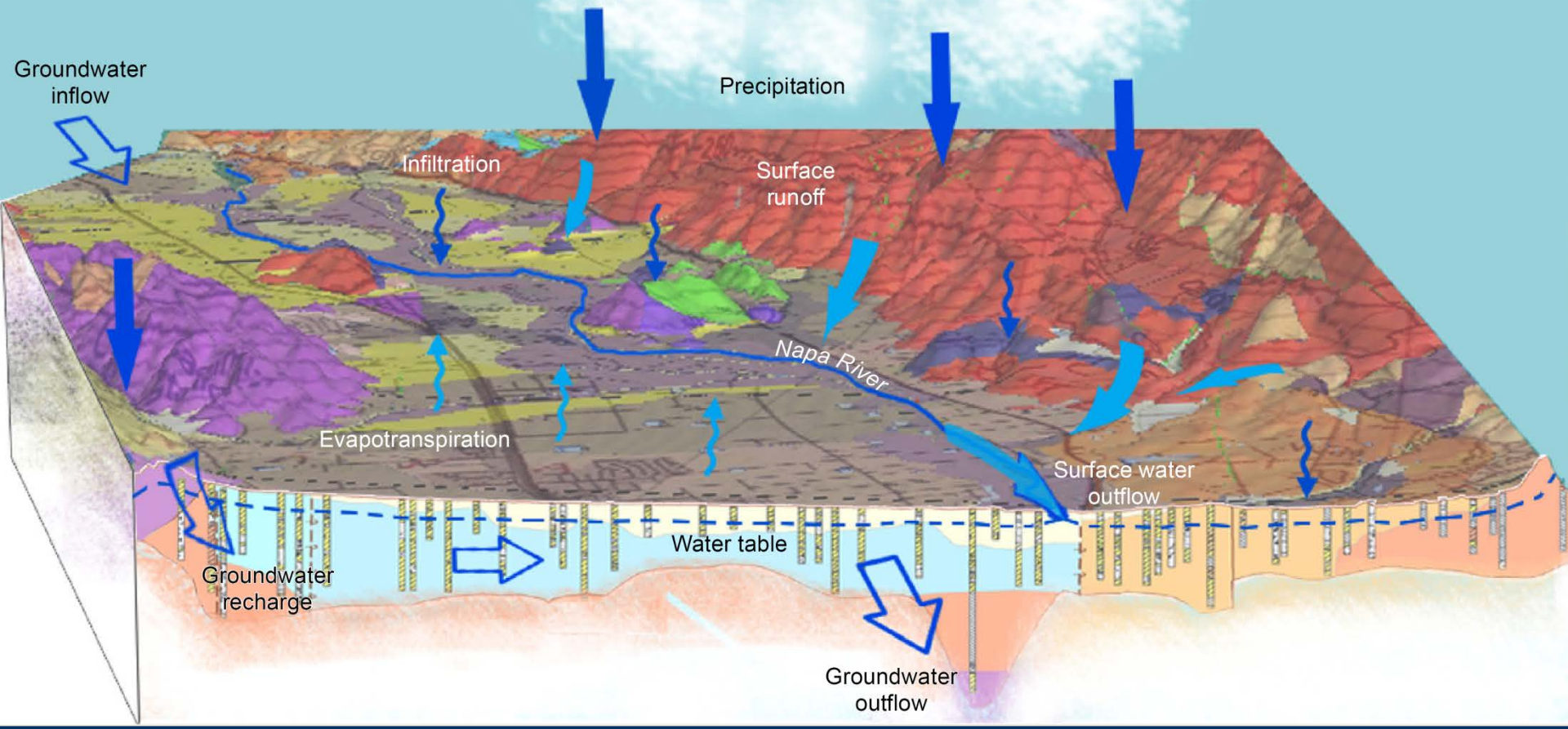



# Napa Valley Subbasin Sustainable Groundwater Management

## Metrics and Tracking: Sustainability Indicators

# Water Budget:
# Core Element of Groundwater Sustainability

***Inflows*** **–** ***Outflows*** **=** **Δ*S*** *Change in GW Storage*



# Water Budget Results

| Est. Inflows (1988-2015) | Avg. Annual Ac-Ft/Yr |
|---|---|
| *Upland Runoff* | *145,000* |
| GW Recharge | 69,000 |
| Imported/Out of Subbasin SW Deliveries | 17,000 |
| Uplands Subsurface Inflow | 5,000 |

−

| Est. Outflows (1988-2015) | Avg. Annual Ac-Ft/Yr |
|---|---|
| *SW Outflow and Baseflow* | *176,000* |
| Net of All GW Use<br>Net of All SW Use | 13,000<br>14,000 |
| GW Subsurface Outflow | 19,000 |
| Urban Waste-water Outflow | 8,000 |

=

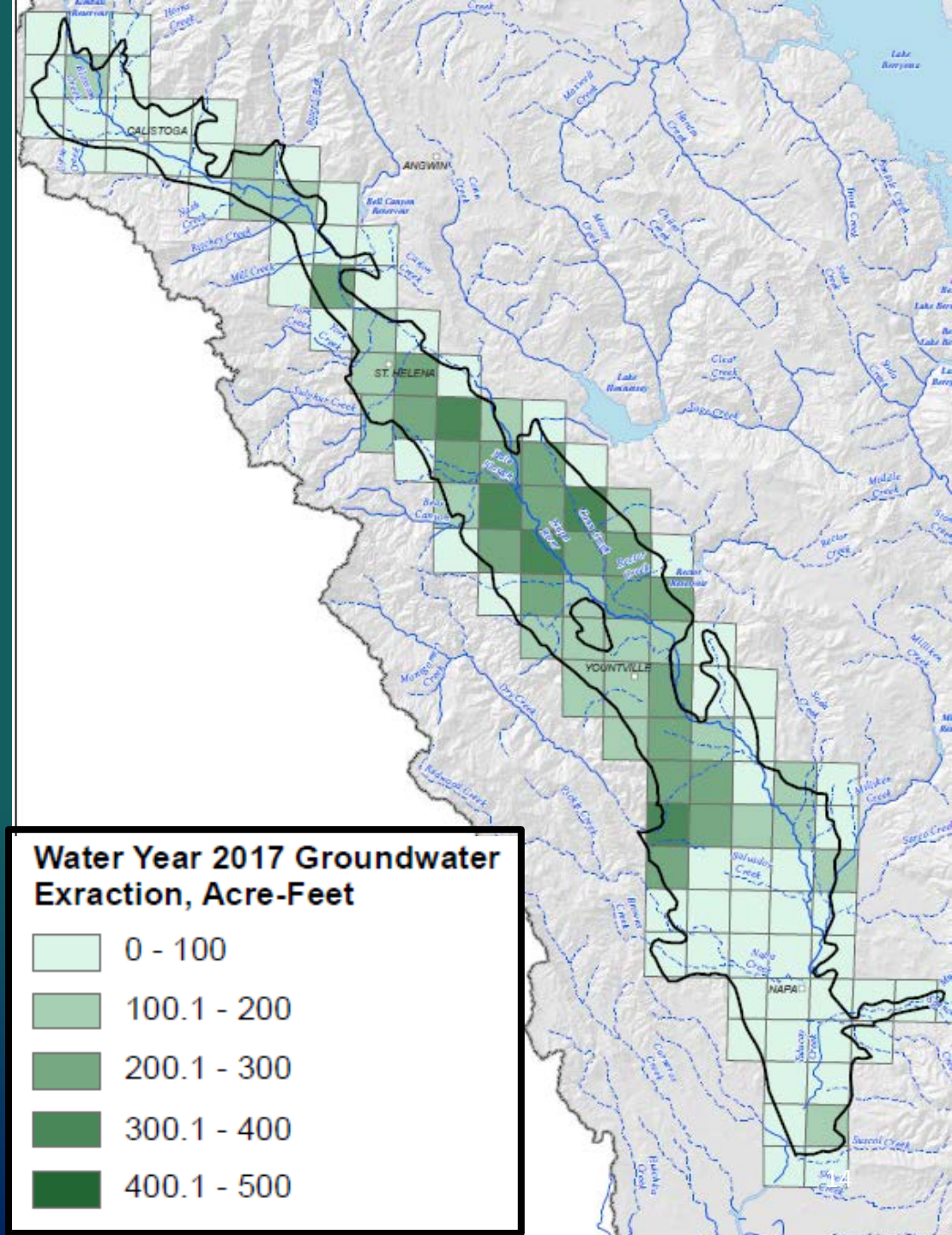
**Net Avg. Annual Change in Subbasin Storage ≈ 6,000 Acre-Ft/Yr**

**(uncertainty in individual budget components; *italicized more uncertain*)**

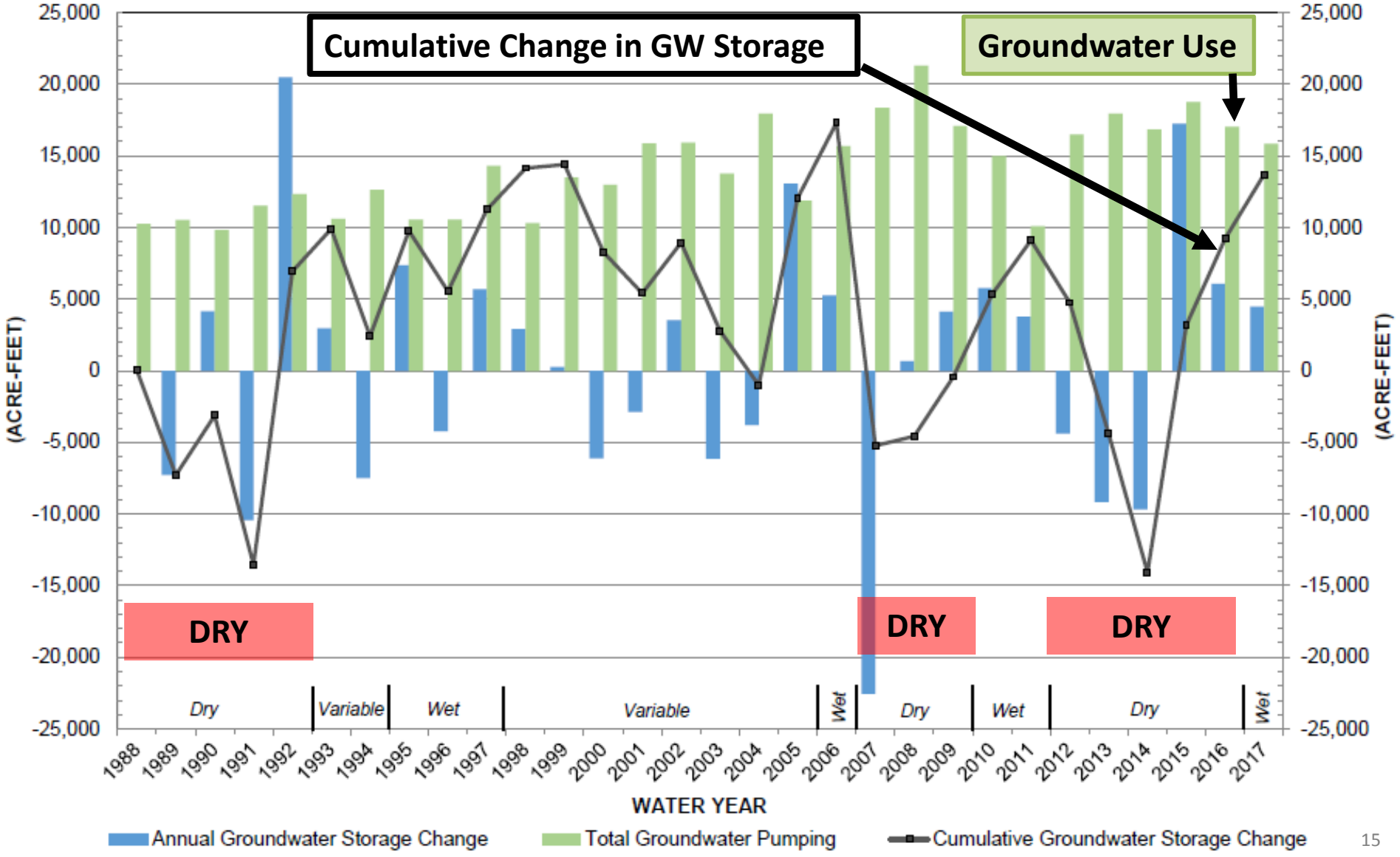
# Groundwater Use (2017 AF)

- Ag: 10,853 (vines & other)
- Municipal: 293
- Unincor. Dom: 363
- Unincor. Landscp: 3,109
- Unincor. Wineries: 1,213

**TOTAL = 15,831 AF**



# Groundwater Use and Storage Change



# Sustainable Yield and Related Terms

## Sustainable Yield

(Definition; Water Code Section 10721(v)):

"*Maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually without causing an undesirable result*."

## Undesirable Result

A key term linked to accomplishing sustainability.

# Summary of Groundwater Use and Change in Groundwater Storage

| Description | Quantity (Acre Feet) |
|---|---|
| Groundwater Extraction 2016 & 2017 | 17,039 and 15,831 |
| Avg. Annual Recharge (1988-2015) | 69,000 |
| Sustainable Yield (Estimated Range) | 17,000 to 20,000 |
| 2016 and 2017: Annual Storage Change | +6,056 and +4,470 |
| 1988-2017: Cumulative Storage Change | **+13,702** |
| | |

…… The County and everyone living and working in the county will integrate stewardship principles and measures in groundwater development, use, and management to protect economic, environmental, and social benefits and **maintain groundwater sustainability indefinitely without causing undesirable results**, including unacceptable economic, environmental, or social consequences.
(Excerpt Napa SGMA Sustainability Goal)

# Groundwater Sustainability Indicators

**Not Causing Undesirable Results:**
**Means Avoiding Significant and Unreasonable …**

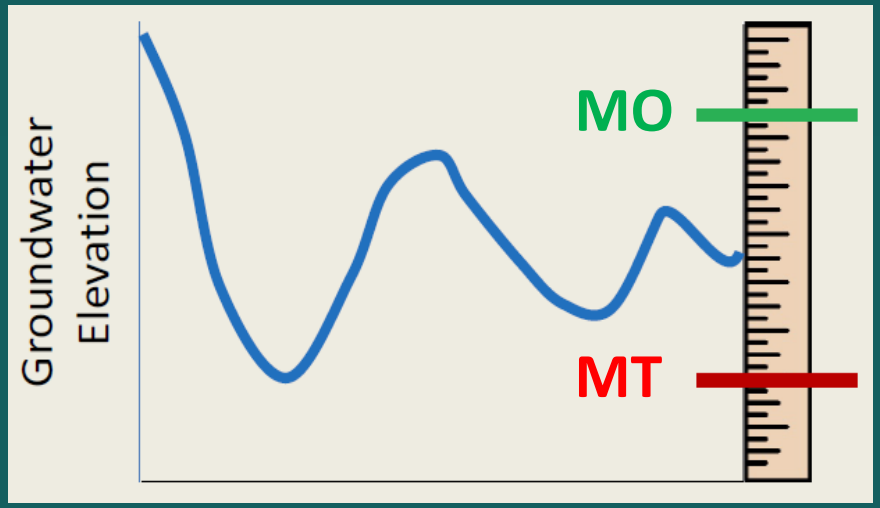
| | | |
|---|---|---|
| **Lowering of GW Levels** | **Reduction of GW Storage** | **Seawater Intrusion** |
| **Water Quality Degradation** | **Land Subsidence** | **Depletion of Surface Water** |

**Napa Valley Hydrogeologically Sensitive to this Indicator**

# Minimum Thresholds and Measurable Objectives

- **Minimum Threshold (MT)**

"a numeric value for each sustainability indicator used to define undesirable results" (Sec 351)




(DWR, March 2016)

- **Measurable Objective (MO)**

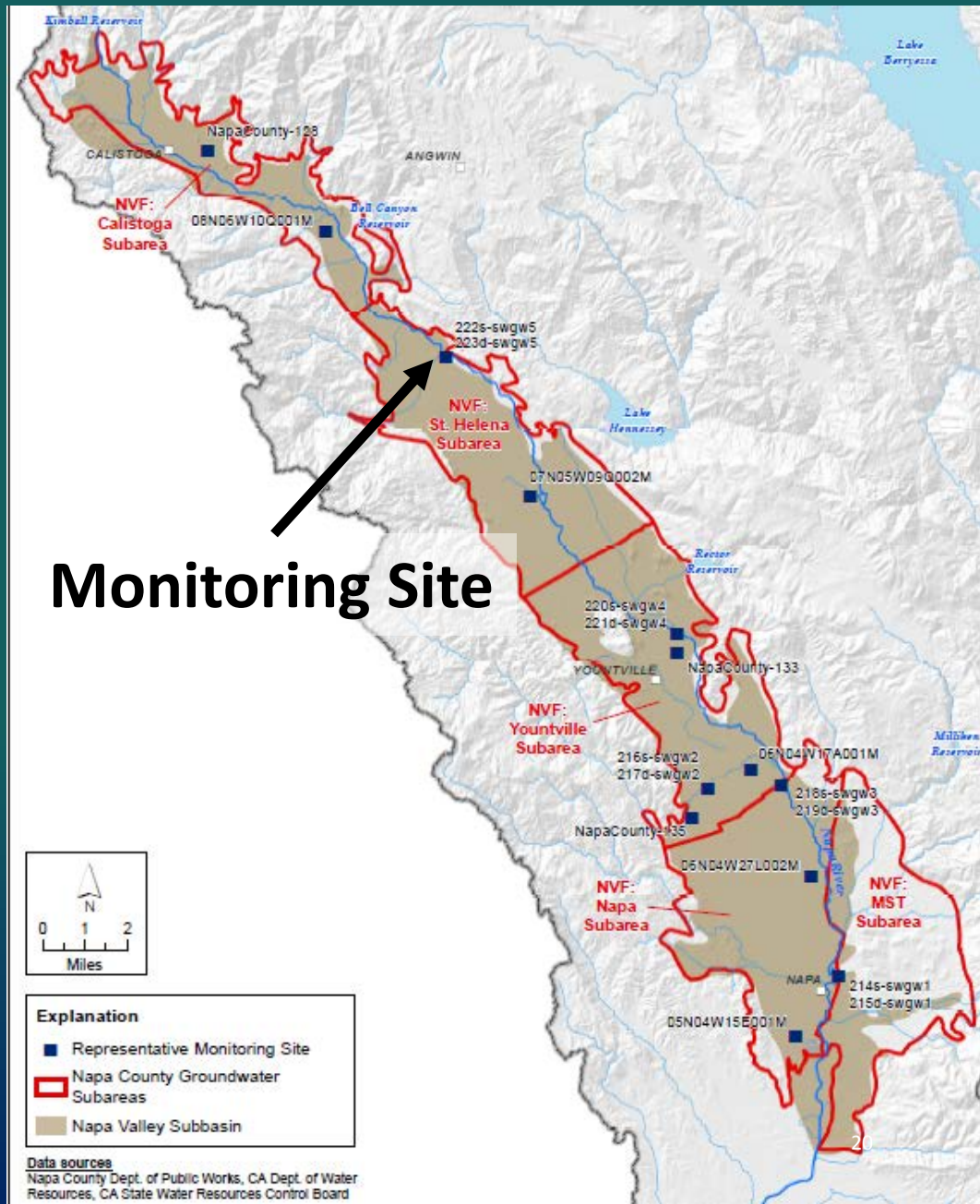
"specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions" (Section 351)

**Measurable objectives and minimum thresholds are established to ensure GW sustainability or improve GW conditions.**

# SGMA Representative Monitoring Sites

- Representative wells to ensure sustainability
- 18 locations
- Metrics for each sustainability indicator, as applicable

Ongoing:
Other Countywide GW Data to be Analyzed, Updated, & Reported (107 wells)



# Sustainability Indicators: Streamflow

| Representative Monitoring Sites Well ID | Date Monitored | Measured Minimum 2017 Fall WLE (Feet, AMSL)[1] | Streamflow Depletion | |
|---|---|---|---|---|
| | | | Minimum Threshold (Fall GWE, Feet AMSL) | Measurable Objective (Fall GWE, Feet AMSL) |
| 06N04W17A001M[2] | - | Fire in area | 37 | 50 |
| 06N04W27L002M | 9/25/2017 | 12.3 | -2 | 12 |
| 07N05W09Q002M | 9/25/2017 | 135 | 127 | 135 |
| 08N06W10Q001M | 9/25/2017 | 282 | 269 | 281 |
| NapaCounty-76[3] | - | Fire in area | - | - |
| NapaCounty-122 | 11/8/2017 | -23 | - | - |
| NapaCounty-128 | 10/3/2017 | 331 | 320 | 331 |
| NapaCounty-133 | 10/25/2017 | 75 | 72 | 76 |
| NapaCounty-135 | 10/26/2017 | 38 | - | - |
| Napa County 214s-swgw1 | 10/22/2017 | 2 | 2 | 4 |
| Napa County 215d-swgw1 | 11/6/2017 | 2 | 2 | 4 |
| Napa County 216s-swgw2 | 11/7/2017 | 74 | 61 | 76 |
| Napa County 217d-swgw2 | 10/30/2017 | 64 | 61 | 76 |
| Napa County 218s-swgw3 | 11/17/2017 | 33 | 29 | 32 |
| Napa County 219d-swgw3 | 10/24/2017 | 33 | 29 | 32 |
| Napa County 220s-swgw4 | 10/31/2017 | 77 | 75 | 77 |
| Napa County 221d-swgw4 | 10/25/2017 | 77 | 75 | 77 |
| Napa County 222s-swgw5 | 10/15/2017 | 187 | 185 | 190 |
| Napa County 223d-swgw5 | 9/26/2017 | 168 | 164 | 175 |
| NapaCounty-229 | 11/8/2017 | -62 | - | - |

**All above Minimum Threshold**

# 2017 Annual Report: Summary

- GW levels stable in majority of wells Napa Valley Subbasin
  - Year-to-year declines observed in a few wells (SE St. Helena area; SW Yountville area; NE Napa area)
  - Some response to drought conditions, with subsequent recovery in 2016 and 2017
- GW level declines in MST moderated
  - Some wells stabilized since 2008/2009
  - Some wells stabilized in more recent years

# 2017 Annual Report: Recommendations

- Refine MW Distribution
  - Address data gaps
  - Collaborate with cities & others
- Ongoing WQ Sampling
- Improve Data Collection from Discretionary Permittees
- Evaluate Recharge and Water Conservation Opportunities
- Evaluate Groundwater Dependent Ecosystem Distribution
- Groundwater Ordinance Updates
  - In response to NE Napa Study & Management Area

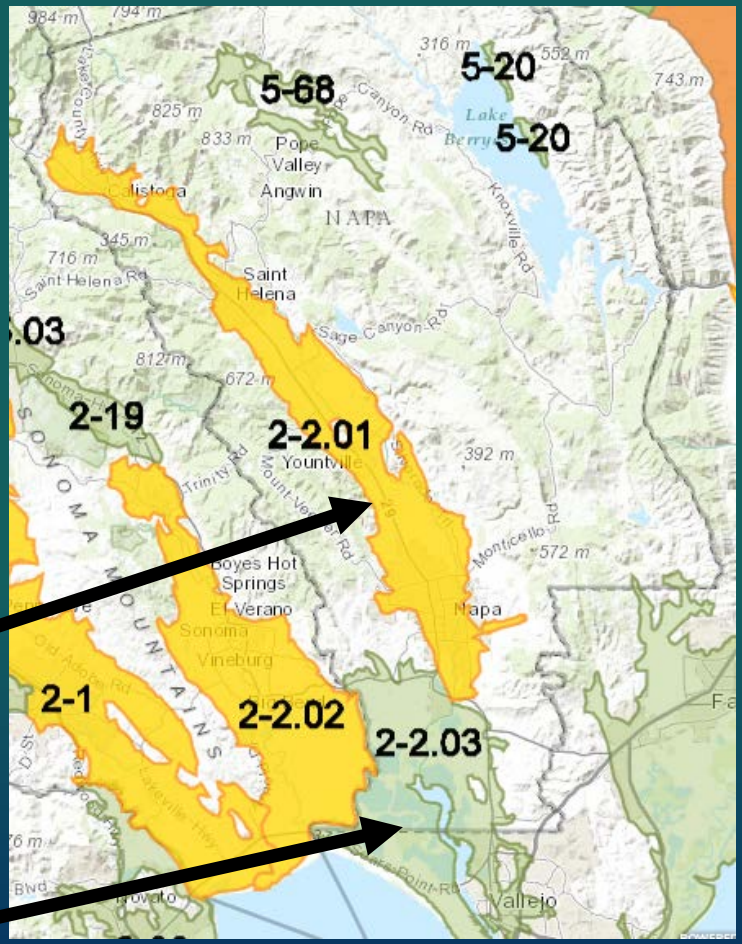
# Basin Analysis Report
# SGMA Implementation Progress

**In addition to 2017 Annual Report, which includes NE Napa Special Study and Amendment to the Basin Analysis Report, activities include:**

- Northeast Napa Management Area Designation
- Revised Conditions of Approval for Discretionary Permits
- Published Well Owner's Guide
- Do It Yourself (DIY) GW Level Monitoring Program
- Napa Valley Subbasin GW Model Dataset Development
- Collaborations to Improve Best Available Water Use Data
- Coordination with Other Water Management & Planning Programs

# Draft 2018 Basin Prioritization

- What is Basin Prioritization?
  - Classification based on factors identified in statute (i.e., population, number of water wells, etc.)
- What do Rankings Mean?
  - Indicator of the overall importance of GW
- Napa Valley Subbasin
  - Medium to High
- Napa Sonoma Lowlands Subbasin
  - Very Low to Medium



# Draft 2018 Basin Prioritization

- What is the significance and practical effect of a change in basin prioritization?
  - "a sustainably managed basin may be designated as high-priority based on which of these factors are present. Changes in status from the 2014 CASGEM prioritization generally reflects changed conditions or new information about existing conditions. Changes in status are not meant as a comment on changes to groundwater management in that basin."(DWR FAQs)

https://water.ca.gov/Programs/Groundwater-Management/Basin-Prioritization

# Napa Valley Subbasin

DWR Priority Ranges

- Very Low (<= 7 points)
- Low (8 - 14 points)
- Medium (15 - 21 points)
- High (> 21 points)

| | 2014 | 2018 Draft | 2018 Review |
|---|---|---|---|
| COMPONENT 1 - POPULATION | | | |
| PRIORITY POINTS | 3 | 3 | 3 |
| COMPONENT 2 - POPULATION GROWTH | | | |
| PRIORITY POINTS | 1 | 2 | 2 |
| COMPONENT 3 - PUBLIC SUPPLY WELLS | | | |
| PRIORITY POINTS | 5 | 5 | 5 |
| COMPONENT 4 - TOTAL WELLS | | | |
| PRIORITY POINTS | 3.75 | 5 | 5 |
| COMPONENT 5 - IRRIGATED ACRES | | | |
| PRIORITY POINTS | 4 | 4 | 4 |
| COMPONENT 6 - GROUNDWATER RELIANCE* | | | |
| PRIORITY POINTS | 3 | 3 | 3 |
| COMPONENT 7 – DOCUMENTED IMPACTS* | | | |
| OVERDRAFT (DECLINING GROUNDWATER LEVELS) IMPACT POINTS | | *0* | *0* |
| SUBSIDENCE IMPACT POINTS | | *0* | *0* |
| SALINE INTRUSION IMPACT POINTS* | | *5* | *0* |
| WATER QUALITY DEGRADATION IMPACT POINTS* | | *3* | *1* |
| PRIORITY POINTS | 1 | 2 | 0 |
| COMPONENT 8 A&B - HABITAT AND OTHER INFO.* | | | |
| PRIORITY POINTS | 0 | 0 | 0 |
| TOTAL PRIORITY POINTS | **20.75** | **24** | **22** |

# Napa Sonoma Lowlands Subbasin

DWR Priority Ranges

- Very Low (<= 7 points)
- Low (8 - 14 points)
- Medium (15 - 21 points)
- High (> 21 points)

| | 2014 | 2018 Draft | 2018 Review |
|---|---|---|---|
| COMPONENT 1 - POPULATION | | | |
| PRIORITY POINTS | 2 | 2 | 2 |
| COMPONENT 2 - POPULATION GROWTH | | | |
| PRIORITY POINTS | 0 | 2 | 2 |
| COMPONENT 3 - PUBLIC SUPPLY WELLS* | | | |
| PRIORITY POINTS | 2 | 3 | 2 |
| COMPONENT 4 - TOTAL WELLS | | | |
| PRIORITY POINTS | 3 | 2 | 2 |
| COMPONENT 5 - IRRIGATED ACRES* | | | |
| PRIORITY POINTS | 2 | 2 | 2 |
| COMPONENT 6 - GROUNDWATER RELIANCE* | | | |
| PRIORITY POINTS | 0 | 2 | 1.5 |
| COMPONENT 7 – DOCUMENTED IMPACTS* | | | |
| OVERDRAFT (DECLINING GROUNDWATER LEVELS) IMPACT POINTS* | | *0* | *0* |
| SUBSIDENCE IMPACT POINTS | | *0* | *0* |
| SALINE INTRUSION IMPACT POINTS | | *5* | *0* |
| WATER QUALITY DEGRADATION IMPACT POINTS* | | *4* | *1* |
| PRIORITY POINTS | 0 | 2 | 0 |
| COMPONENT 8 A&B - HABITAT AND OTHER INFO.* | | | |
| PRIORITY POINTS | 0 | 0 | 0 |
| | | | |
| TOTAL PRIORITY POINTS | **9** | **15** | **11.5** |

# Public Water Supply Wells – Lowlands Subbasin

- 2018 Draft Prioritization: PWS well density 0.26 PSW/sq. mile (as of 3/2016)
- Available GAMA WQ and SDWIS data:
  - 3 of 17 PWS wells located outside of Subbasin; one well is hundreds of miles outside Subbasin
- Recalculated PSW well density (Lowlands) is 0.22 PSW per square mile
- **Priority Point score for Component 3 should be revised to 2**

# GW Reliance – Lowlands Subbasin

- 2014 Basin Prioritization
  - 1,062 AF Annual GW use (16% of total supply)
  - 5,159 irrigated acres (2010)
- 2018 Draft Prioritization
  - 5,449 AF Annual GW use (increased 413%)
  - 4,880 irrigated acres
- Publicly available data finds GW use about 3,500 AFY (22% of total water supply).
- **Priority Point score for Component 6 should be revised to 1.5**

# Salt Water Intrusion – Lowlands and NV Subbasins

- DWR cites USGS (1995), which references DWR (1975)
  - DWR (1975) refers to 1962 data
  - Areas interpreted as having chloride greater than 100 ppm (CA secondary Cl MCL = 250 ppm)
  - DWR (1975): no attribution of cause associated with Cl
- USGS (1960): possible reasons for Cl conc. in area including:
  - Tidal marsh area south of Napa; in alluvial plain along Napa River in and south of Napa; Cl content of water is relatively high
  - Younger alluvium in area south of Napa deposited in brackish water of San Pablo Bay; may have extended north to/beyond Napa, and the salty water is at least partly connate
  - Connate water may also originate from Sonoma Volcanics
- USGS (1995): no new info; no evaluation of trends
- Does not constitute a "documented impact" in accordance with Water Code §10933(b)(7)
- **Impact score for salt water intrusion should be revised to a score of 0**

# WQ Degradation – Lowlands and NV Subbasins

- Included all naturally-occurring constituents (i.e., Fe and Mn)
  - Not consistent with WC §10933, which requires prioritization that includes "impacts on the groundwater basin, including… water quality degradation"
- MCLs for naturally-occurring constituents do not necessarily reflect an "impact"
- Spatial distribution of WQ exceedances and/or temporal trends not considered
  - Equal weight to any result in a well any time over 17-yr period, regardless of when and how many times it occurred, even when another result from the same well with the same sample date found no MCL exceedance
  - No documented basin-wide reduction in WQ over time
- **Impact score for WQ degradation should be revised to a score of 1**
- **Priority Point score for Documented Impacts should be revised to a score of 0**

# Napa Earthquake Paper & Article

- AGU Journal article by Meredith Kraner and others "Seasonal non-tectonic loading inferred from cGPS as a potential trigger for the M6.0 South Napa Earthquake", (Journal of Geophysical Research: Solid Earth)
- Liza Lester (AGU journalist) wrote article "South Napa earthquake linked to summer groundwater dip" about the Kraner et al. paper.
  - Kraner: "We think it's more of a localized effect, something related to the groundwater system. We don't know if it is groundwater pumping specifically, or something related to how the natural aquifer system works, or a combination."

**What groundwater data and information are included in Kraner paper?**

# Kraner Paper

- **No** GW level data for Napa & Sonoma Valley Subbasins
- **No** GW pumping data for Napa & Sonoma Valley Subbasins
- Only source of GW-related information summed up in one sentence:

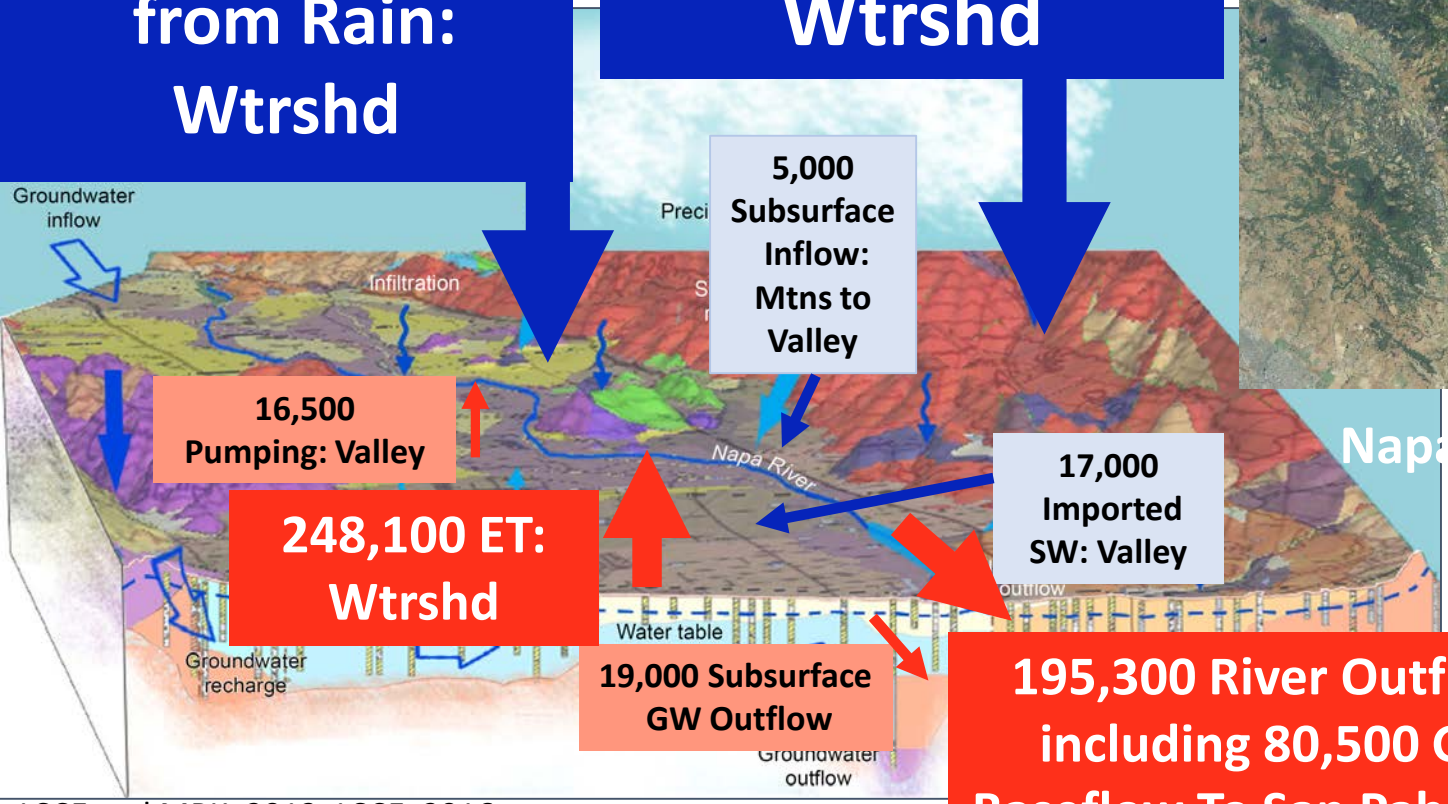
  "This subsidence is consistent with basin contraction from known water pumping [Kunkel and Upson, 1960] and is sufficient to qualitatively explain the several-mm of horizontal motion of stations P199 and P200 toward the center of the subbasin."

# What is known from local GW Data, GW Conditions, cGPS and InSAR Data?

# Napa Watershed: Average Annual Water Budget Components (AFY)

**327,100 Infiltration from Rain: Wtrshd**

**522,400 Precip: Wtrshd**




**5,000 Subsurface Inflow: Mtns to Valley**

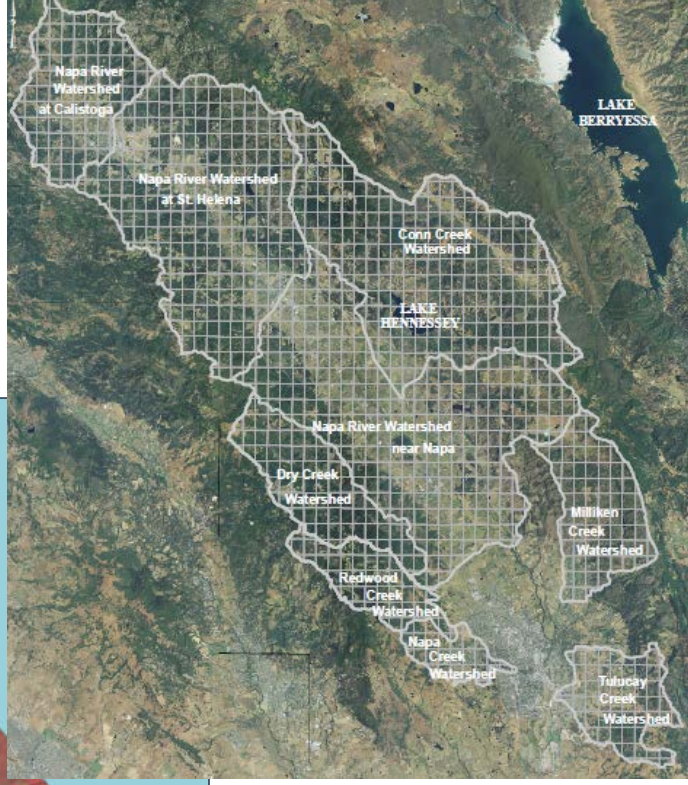
**16,500 Pumping: Valley**

**248,100 ET: Wtrshd**

**17,000 Imported SW: Valley**

**19,000 Subsurface GW Outflow**

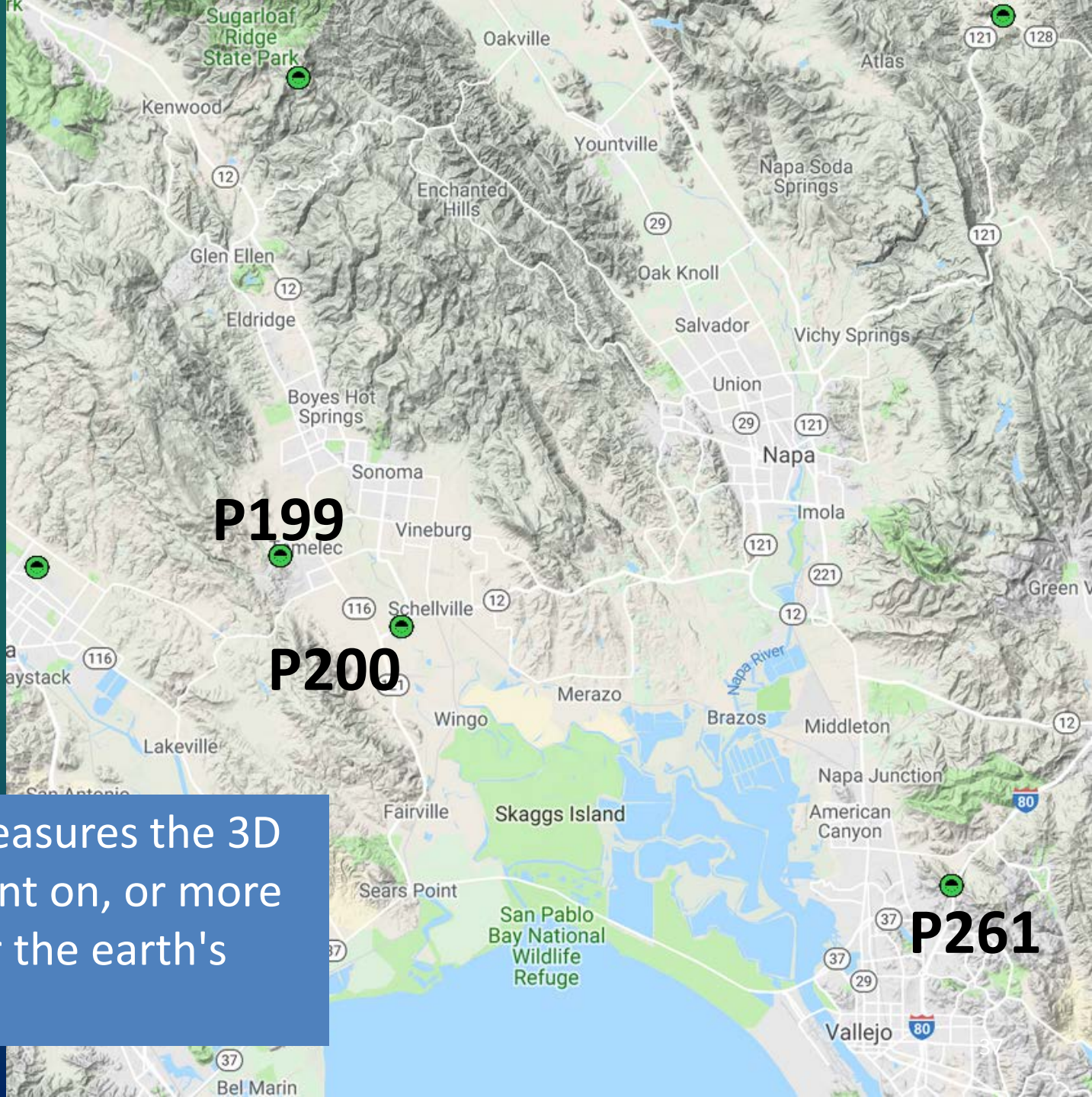
**195,300 River Outflow; including 80,500 GW Baseflow To San Pablo Bay**




LSCE and MBK, 2013; LSCE, 2016

Infiltration and ET in the Napa watershed are about 15 times greater than pumping in the Napa Valley Subbasin.

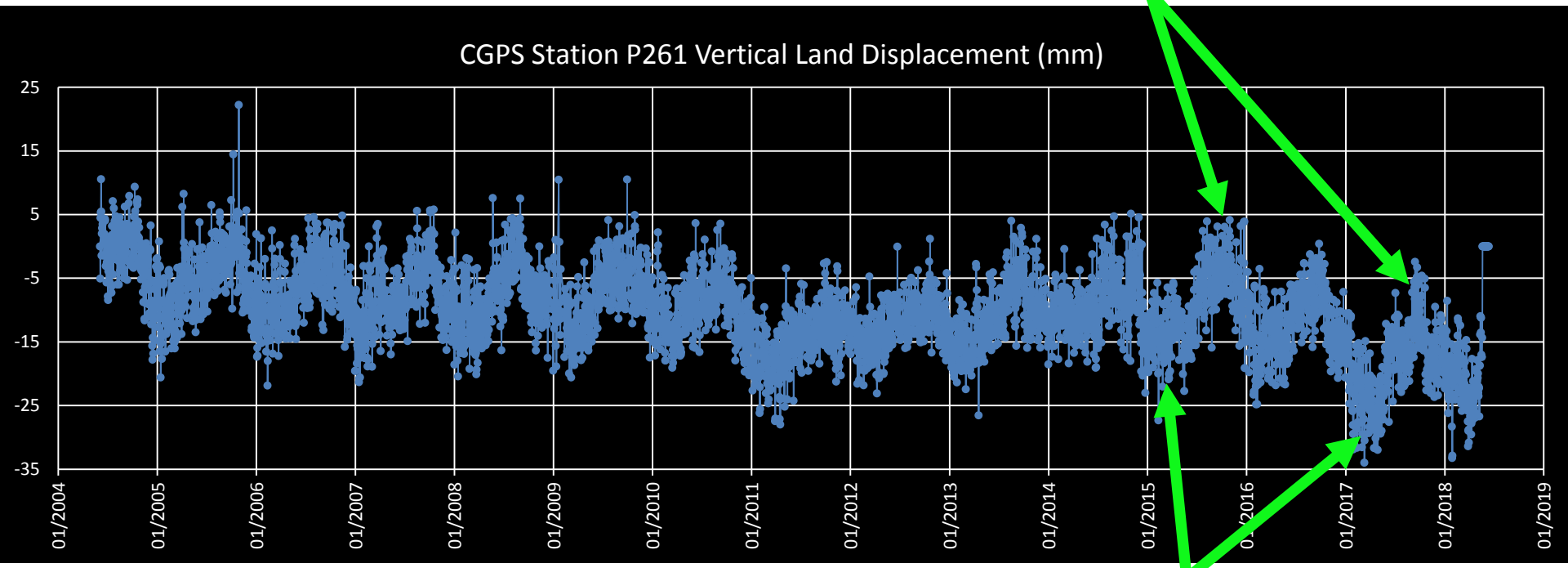
# UNAVCO cGPS Stations




Continuously measures the 3D position of a point on, or more specifically, near the earth's surface

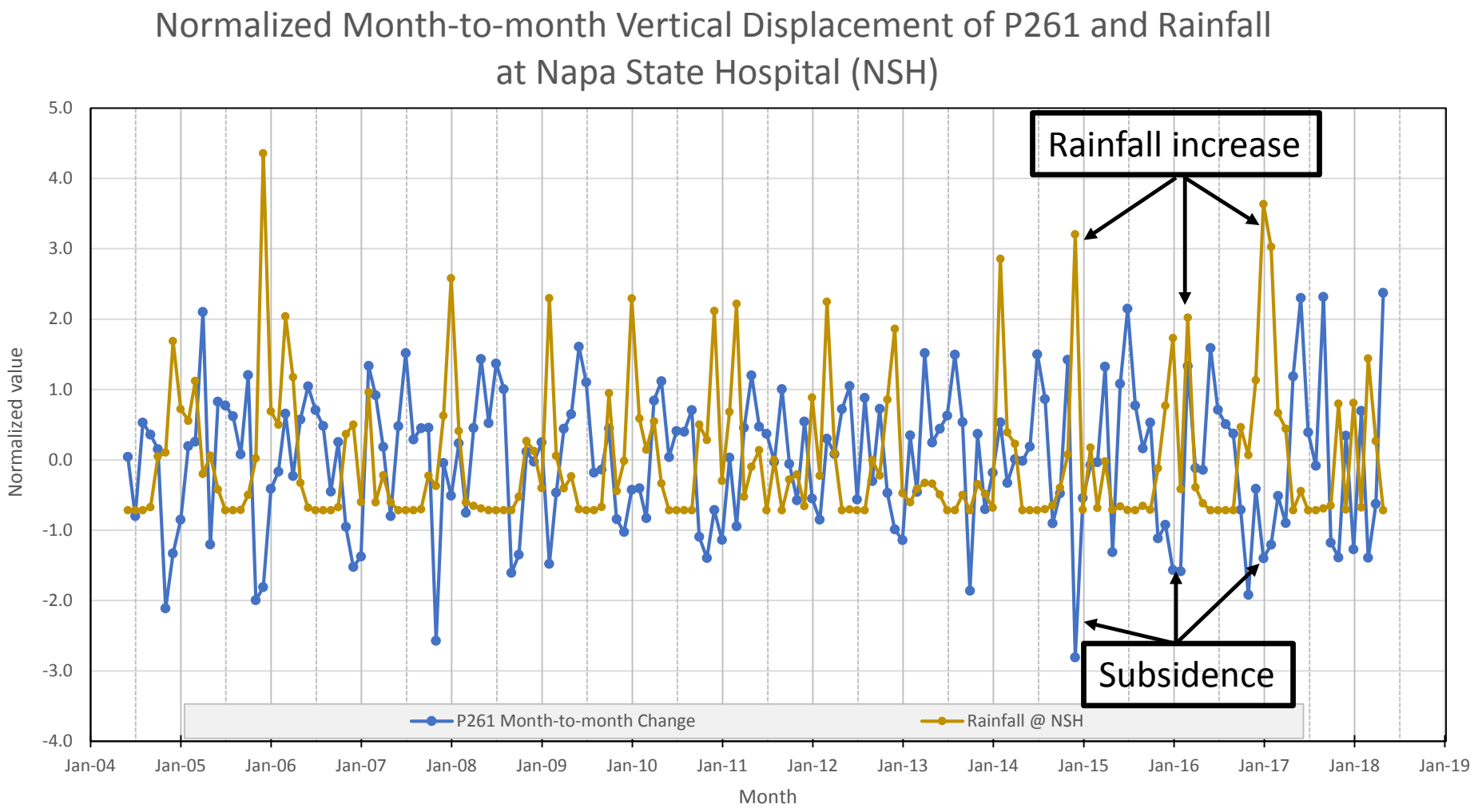
# cGPS Station P261 Vallejo

Max Vertical Displacement (Summer/Fall) **Uplift**

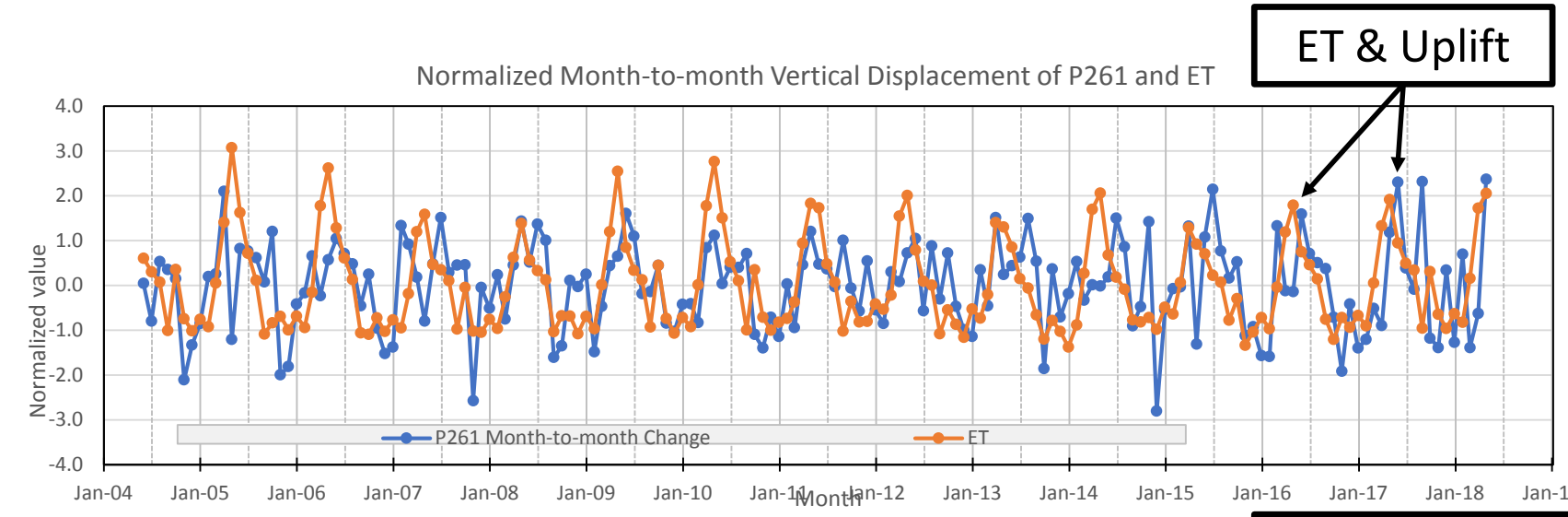


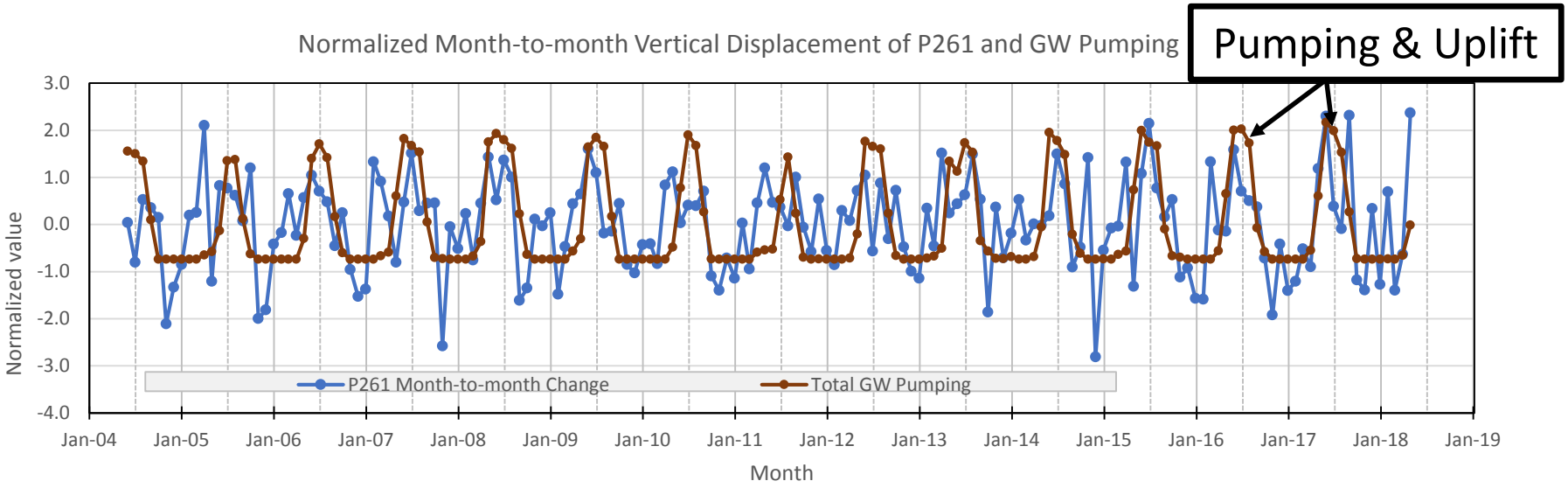

Max Vertical Displacement (Winter/Spring) **Subsidence**

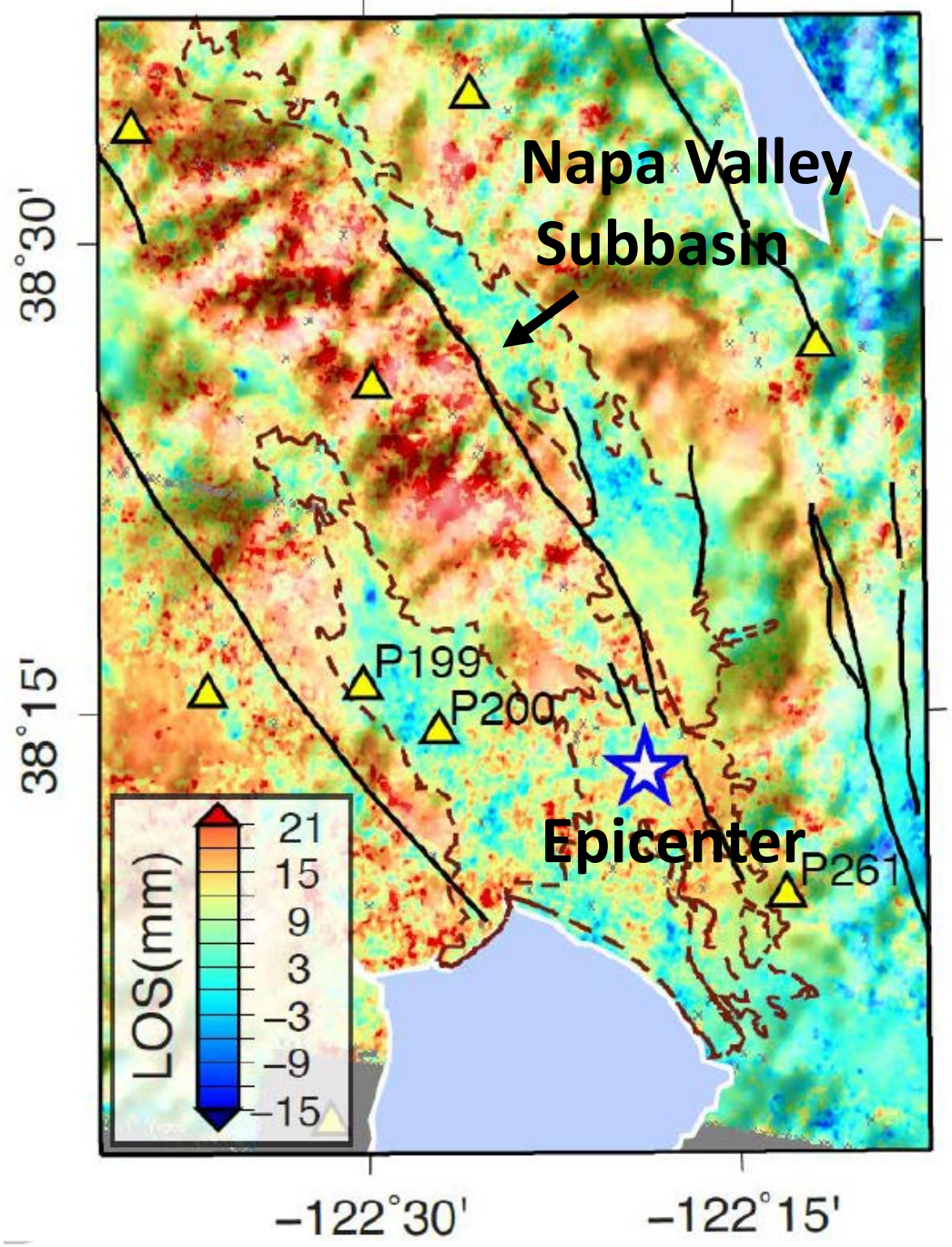
# Napa Valley Subbasin: Rainfall and Subsidence



# Napa Valley Subbasin: ET & Pumping and Uplift



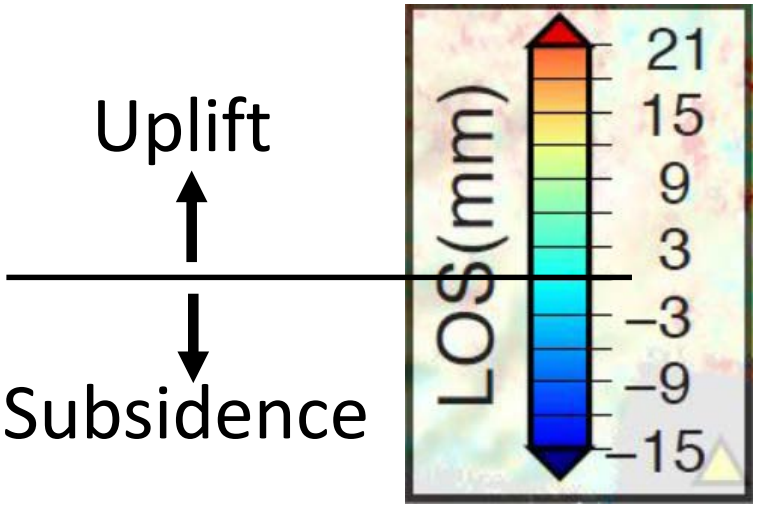






Interferometric Synthetic Aperture Radar

## InSar March 4 to August 19, 2015

- Line-of-Sight Displacement Data: Processed from European Space Agency Sentinel-1A Satellite
- Satellite fully operational as of October 2014 (after the August 2014 earthquake)

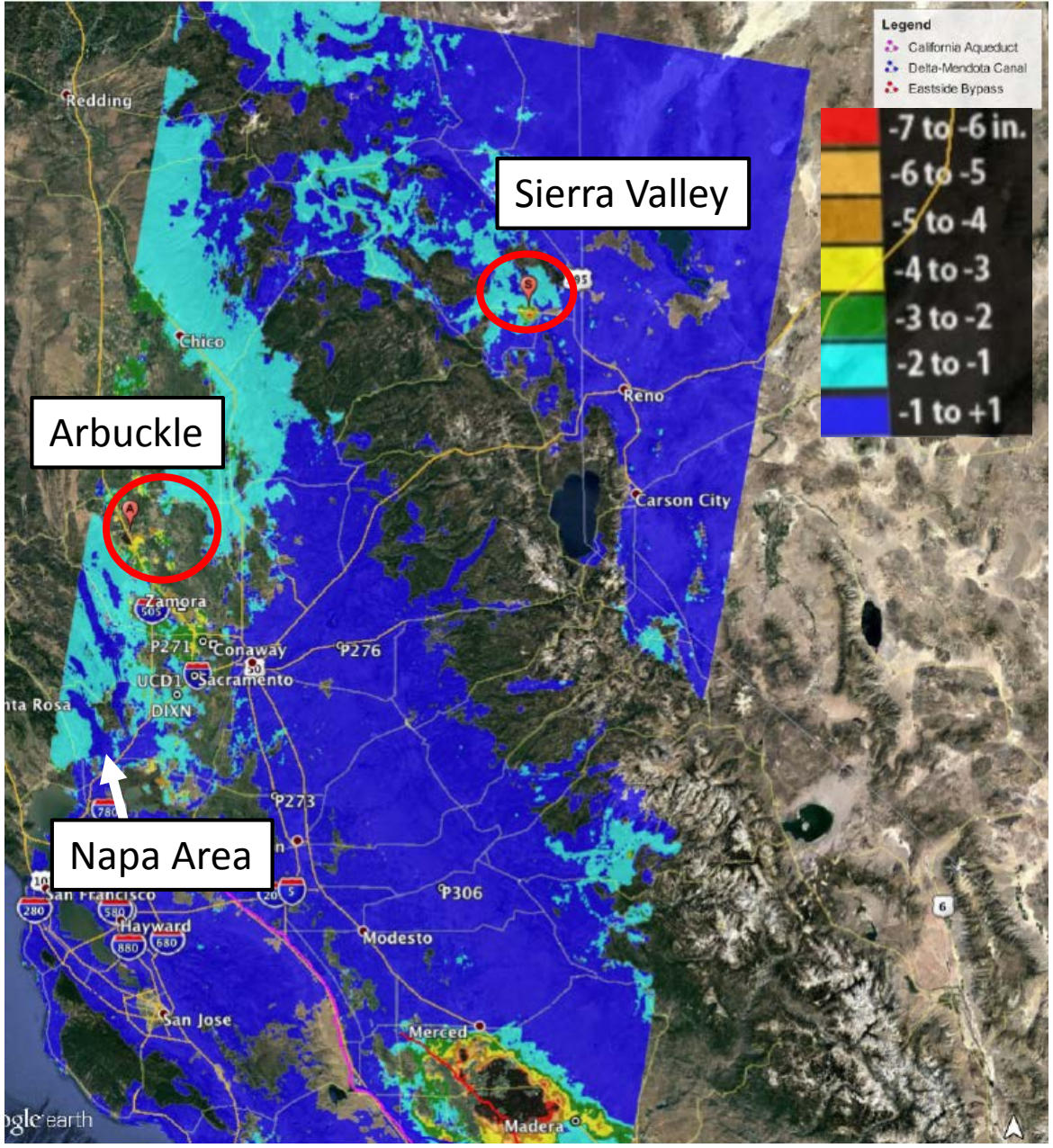



Kraner et al., 2018

# InSAR March 1, 2015 to May 30, 2016

- European Space Agency Sentinel 1A data processed by NASA Jet Propulsion Laboratory, under contract with DWR
- JPL noted subsidence in Sacramento Valley: Arbuckle and Sierra Valley
- Uncertainties associated with vertical displacement measurements were determined to be < 1” and usually < 0.5” (0.5 in. = 12.7 mm)

**No indication of inelastic subsidence in Napa area**




Farr et al., 2016. Progress Report: Subsidence in California, March 2015 - September 2016

# Kraner Paper Lacks Foundation for GW Claims

- Kraner paper: InSAR does not support author's description of "likely anthropogenic subsidence"
- Farr paper: InSAR does not show subsidence in Napa area
- cGPS stations show apparent natural seasonal pattern of loading/ elastic subsidence (winter/spring) and unloading/uplift (summer/fall) for GW system
- Kraner paper: does not discuss vertical displacement exhibited by 3 local cGPS stations
- Kraner paper: analyzes hydrological load changes for western US; relates this to horiz. GPS measurements and concludes "hydrological loading contributes insignificantly to the observed elastic strain and stress inferred from horizontal GPS."

**Kraner paper lacks documentation and speculates on linkage between GW levels and Napa 2014 earthquake. This is concerning and inappropriate without deeper research and discussion of mechanisms to support the suggestion of such a relationship.**

# Vetting Groundwater Information

- Kraner paper abstract: "Vertical deformation within the Sonoma and Napa Valley Subbasins inferred from InSAR explains large horizontal motions at nearby cGPS stations and suggests that groundwater pumping may contribute to observed strain and stress transients."
- However, Kraner said: "We think it's more of a localized effect, something related to the groundwater system. We don't know if it is groundwater pumping specifically, or something related to how the natural aquifer system works, or a combination."
- Groundwater systems and the many factors influencing groundwater conditions are complex; uncertainty is expected. However, speculation and unfounded conclusions should be avoided.

# Next Steps

- Submit comments on DWR 2018 Draft Basin Prioritization for Napa Valley and Lowlands Subbasins
- DWR to complete evaluation of Alternative GSP
- Continue Napa Valley Subbasin GW Model Dataset Development
- Groundwater Ordinance Updates
  - In response to NE Napa Study & Management Area
- Implement other BAR and Annual Report Recommendations

# Thank You