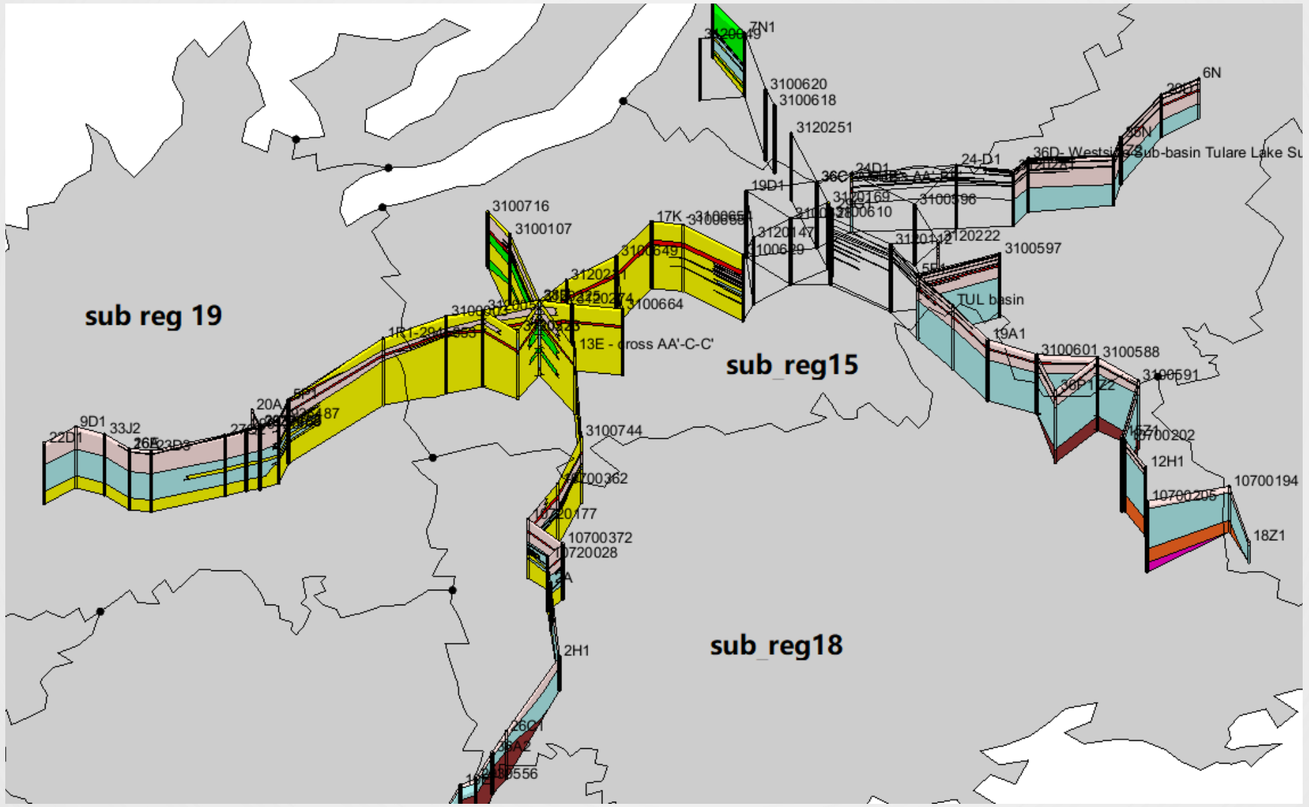
The importance of a Well Developed Stratigraphy for improving the C2VSimFG numerical Model



April 4, 2022

Behrooz Etebari, P.G.

Objectives

- Improve HCM with a finer resolution
- Improve C2VSimFG stratigraphy and texture analysis and model calibration
- Aquifer vs aquitard and confinements set up(such as Amnicola Clay, Tulare Clay and Paloma Clay, pinch outs and etc)
- Compiling and visualizing available data together to leverage not only state datasets, but local data

Tools

GMS GUI, for visualizing borehole data and fence model, making conceptual model

AEM and Seismic reflection surveys

Newly digitized WCRs(OSWCR), County and GSP reports

E-Logs (SP logs, Resistivity logs)

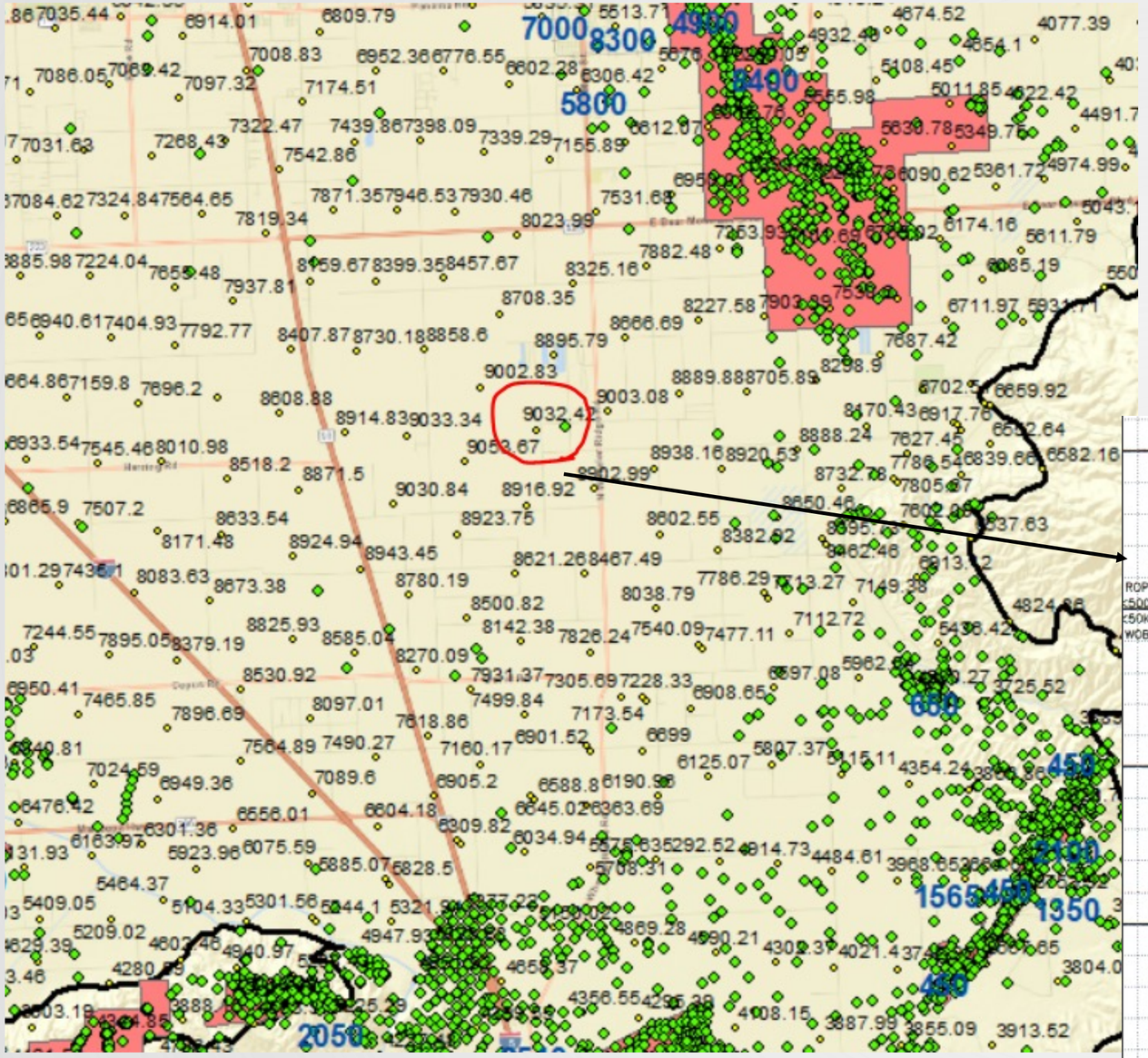
Fault investigation via LIDAR or InSAR

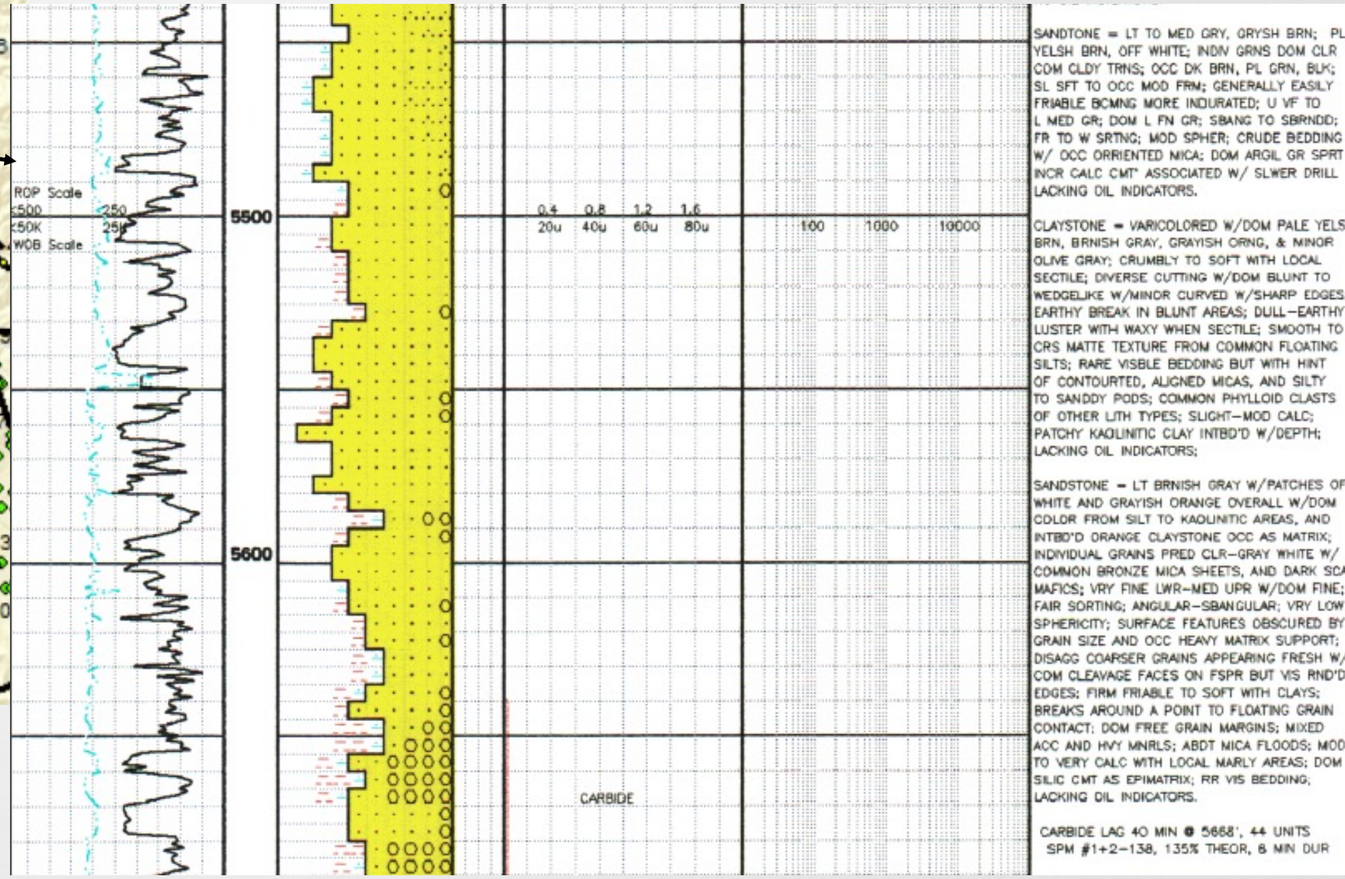
Overlaying AEM, Wire logs and OSWCR

E-(wire) logs and Mud-Logs

DOC, DOGGR

API: 0403003879





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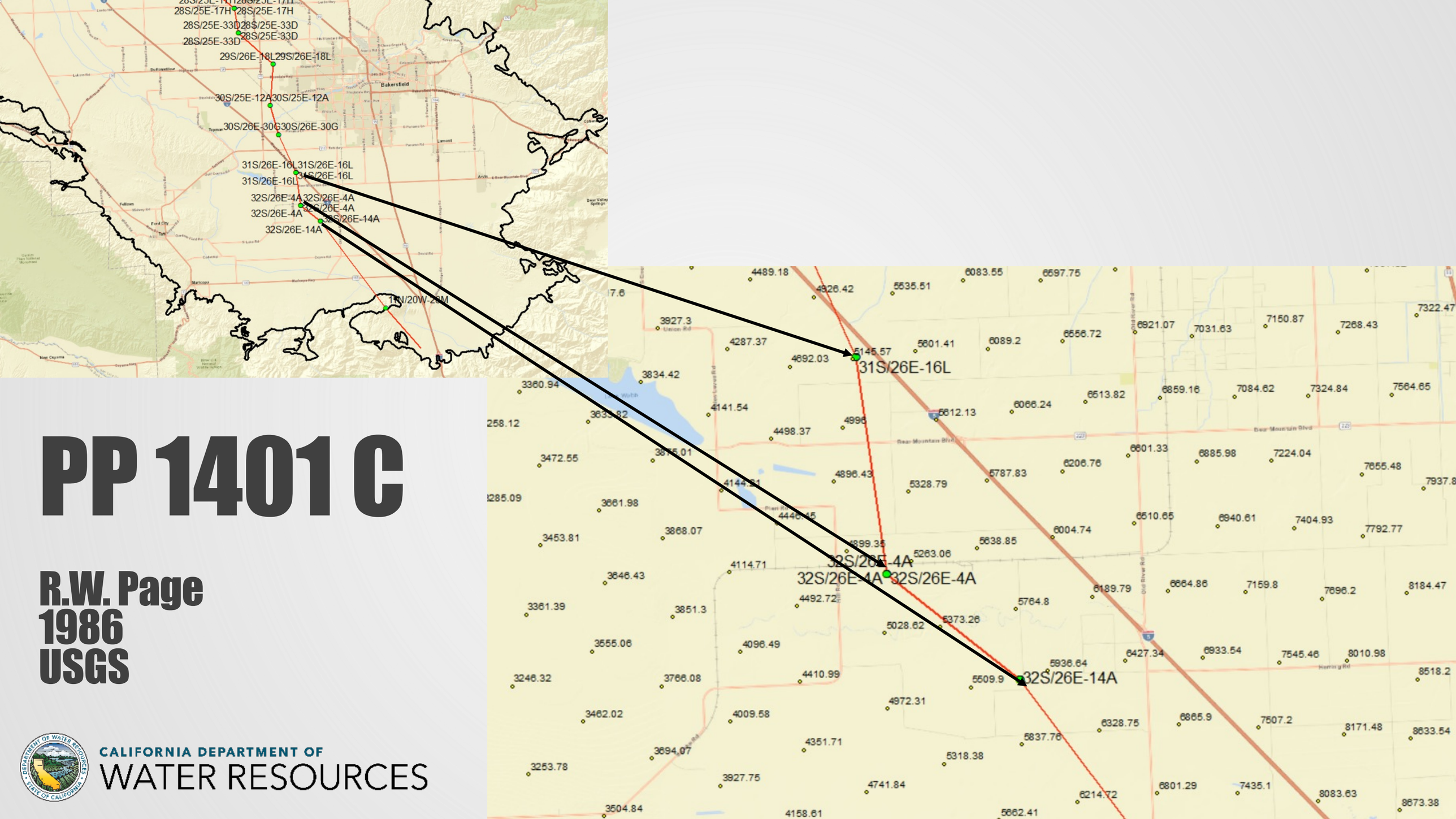

PP 1401 C

R.W. Page
1986
USGS

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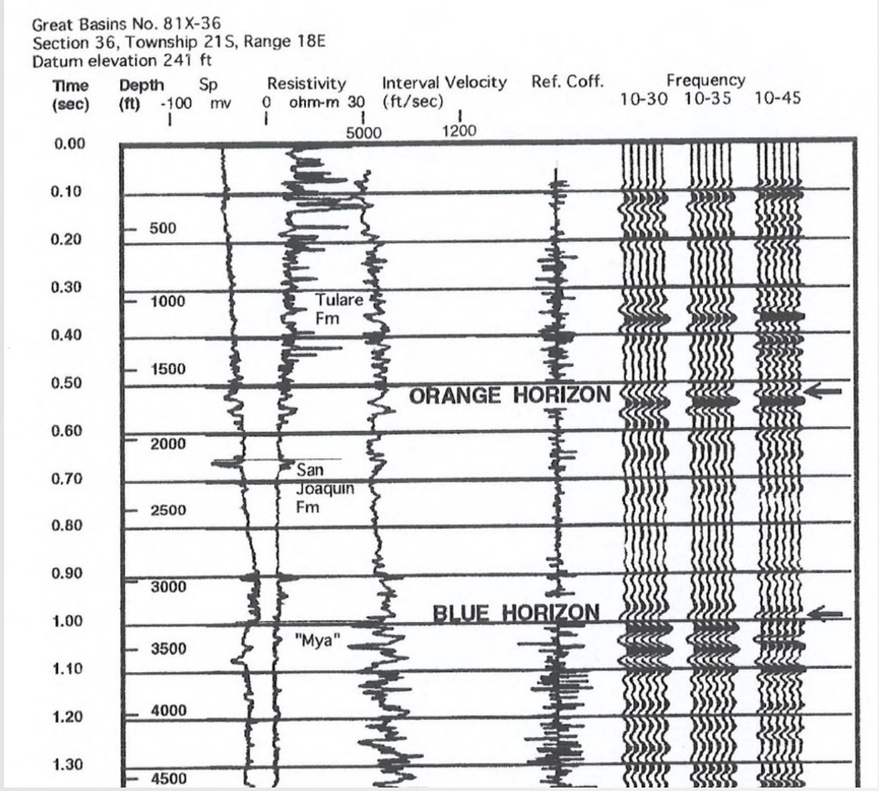
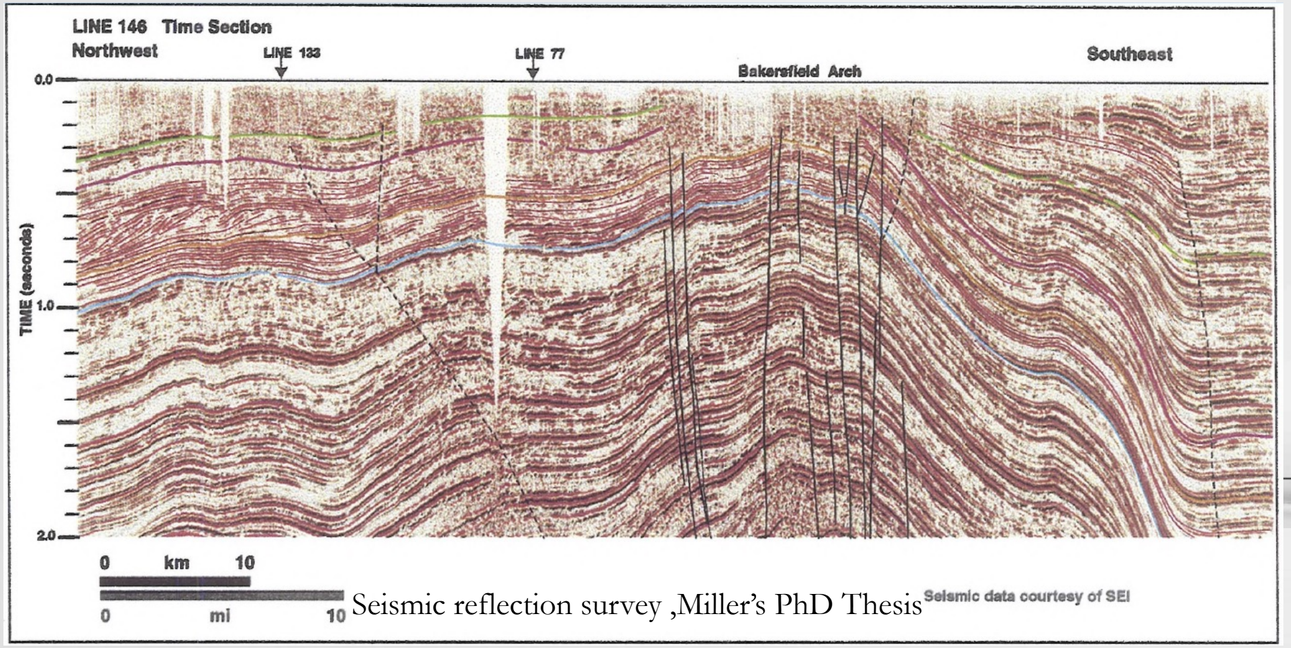
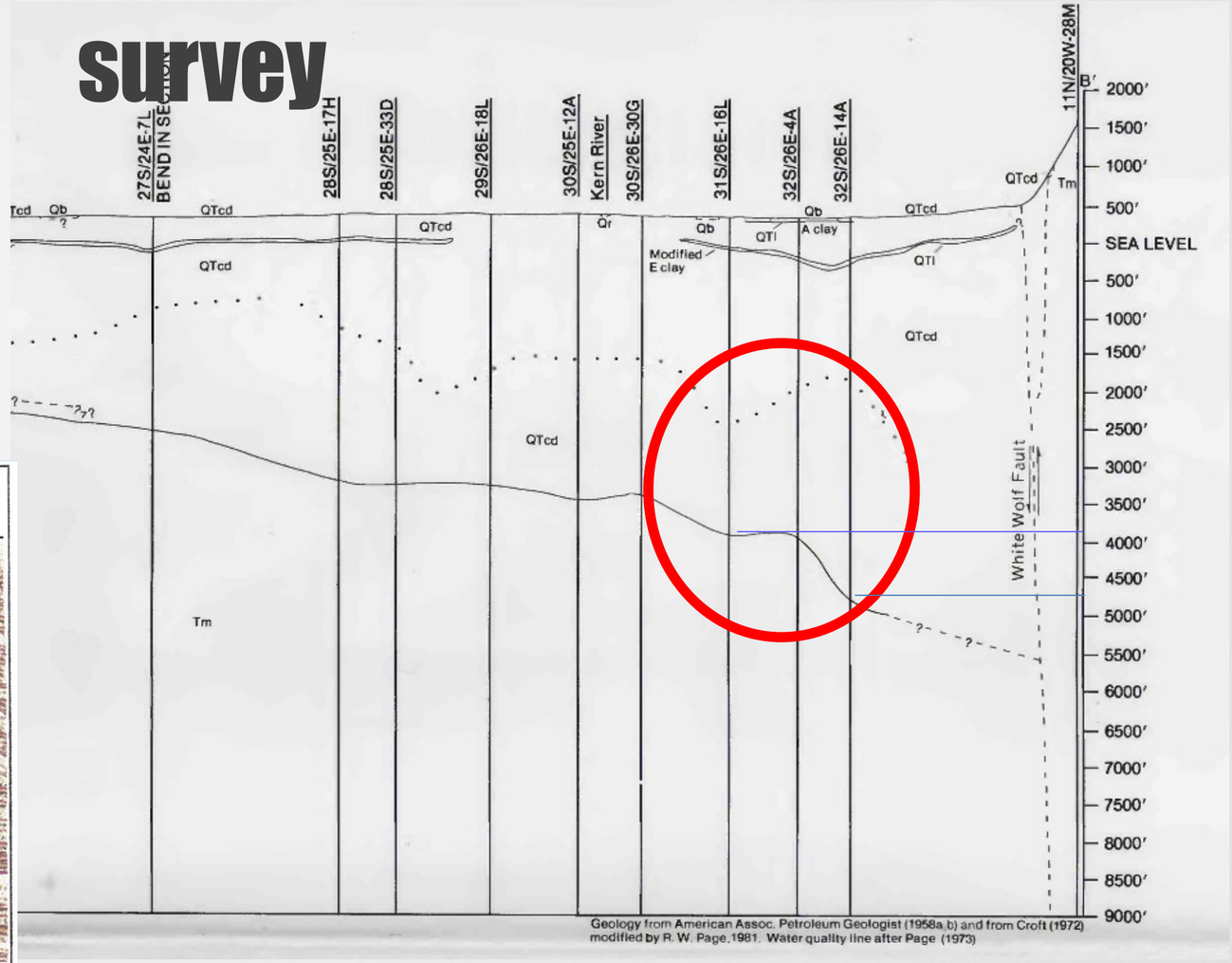
X-Section B-B', PP 1401 C , USGS vs Line146 seismic survey

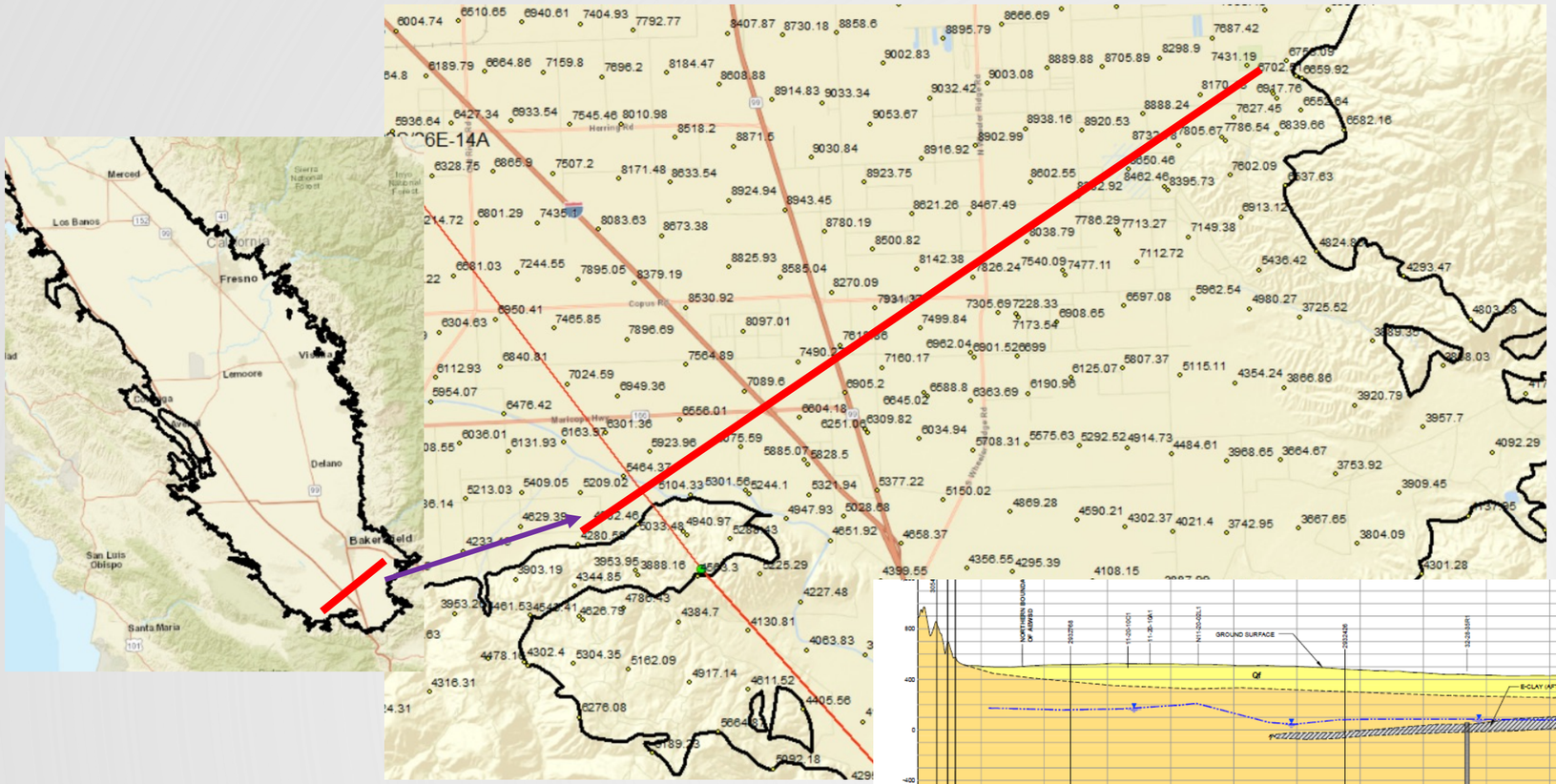


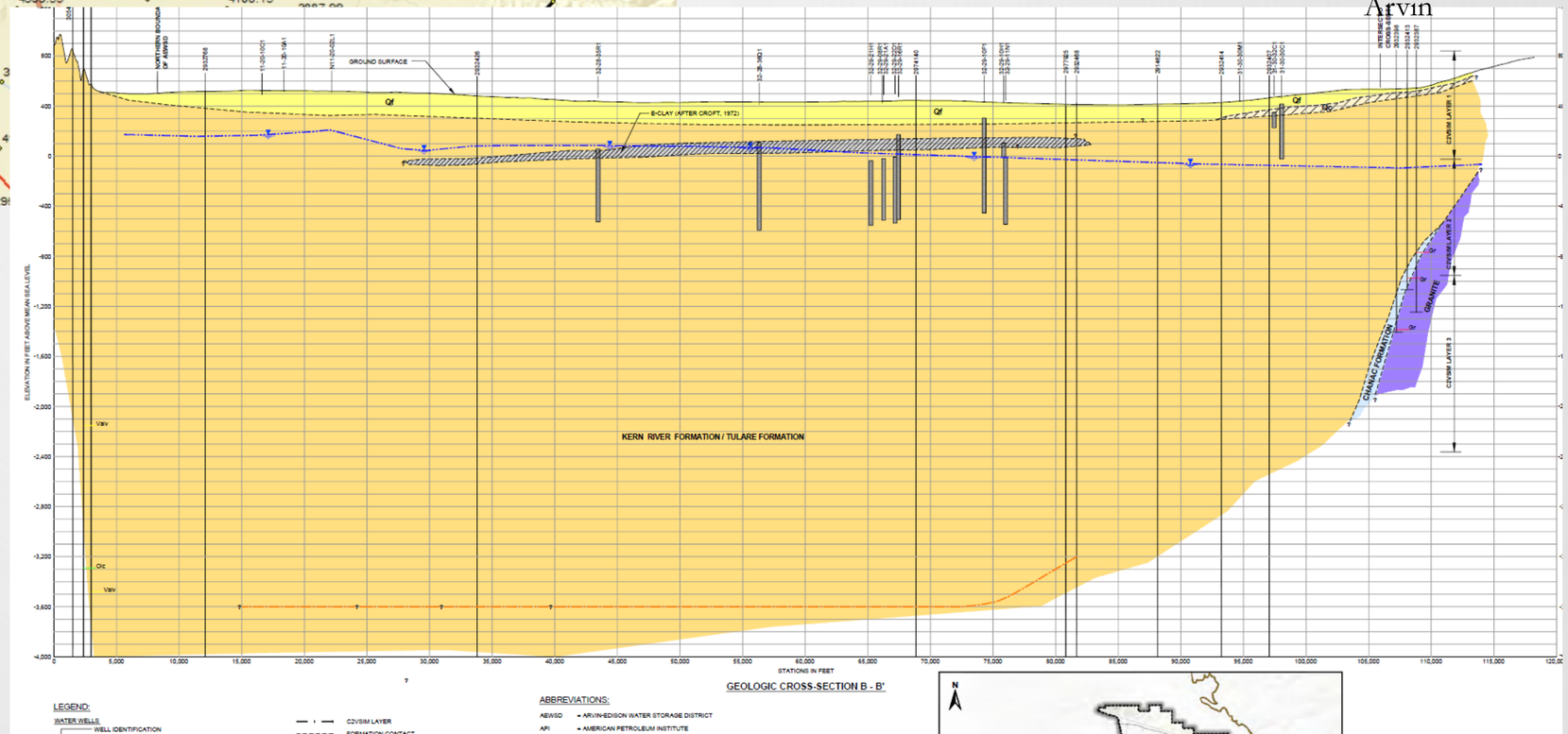


Seismic reflection survey ‚Miller's PhD Thesis



C2VSimFG Nodes Total thickness vs B-B' x-section of Henry Miller Water District GPS





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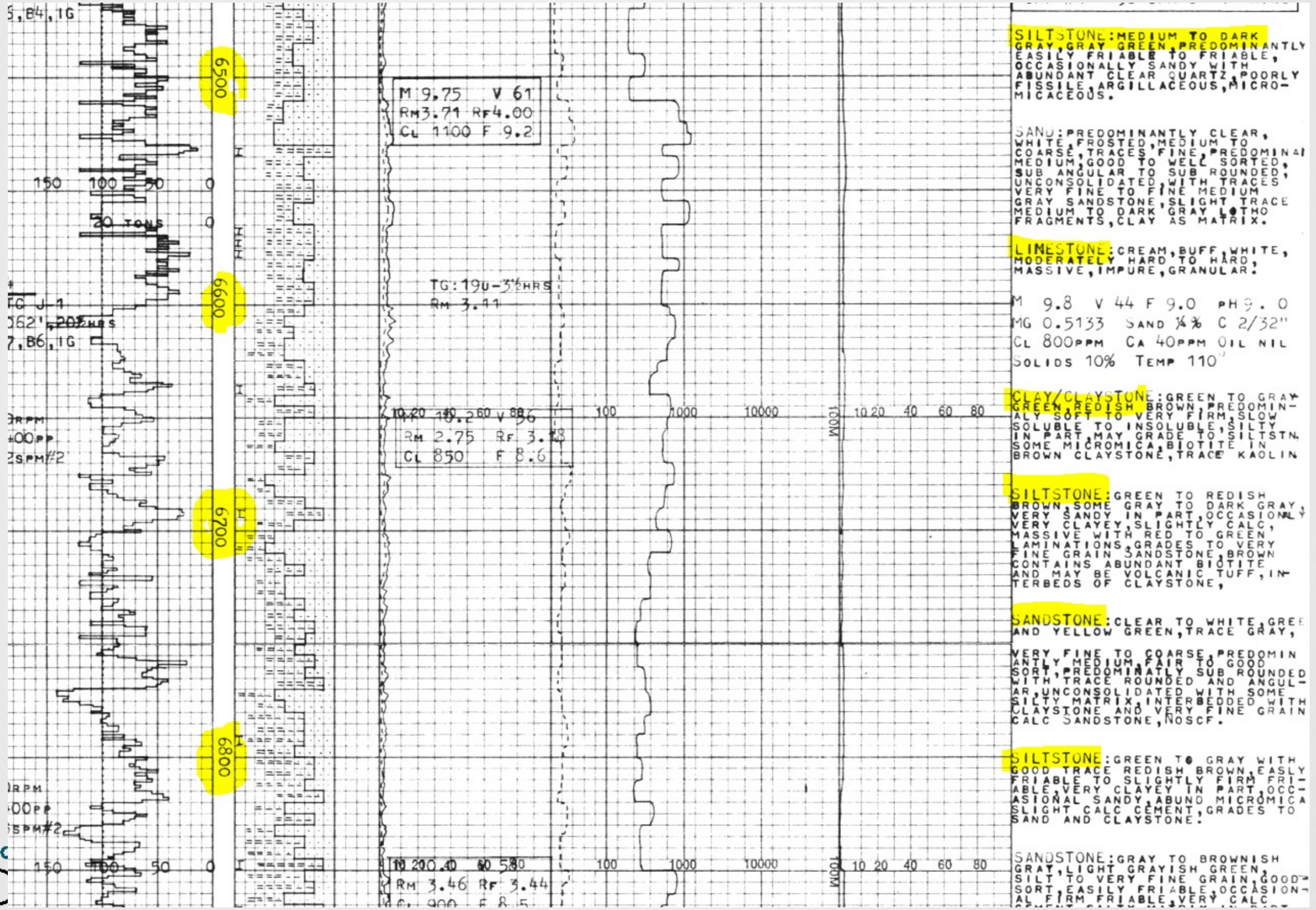
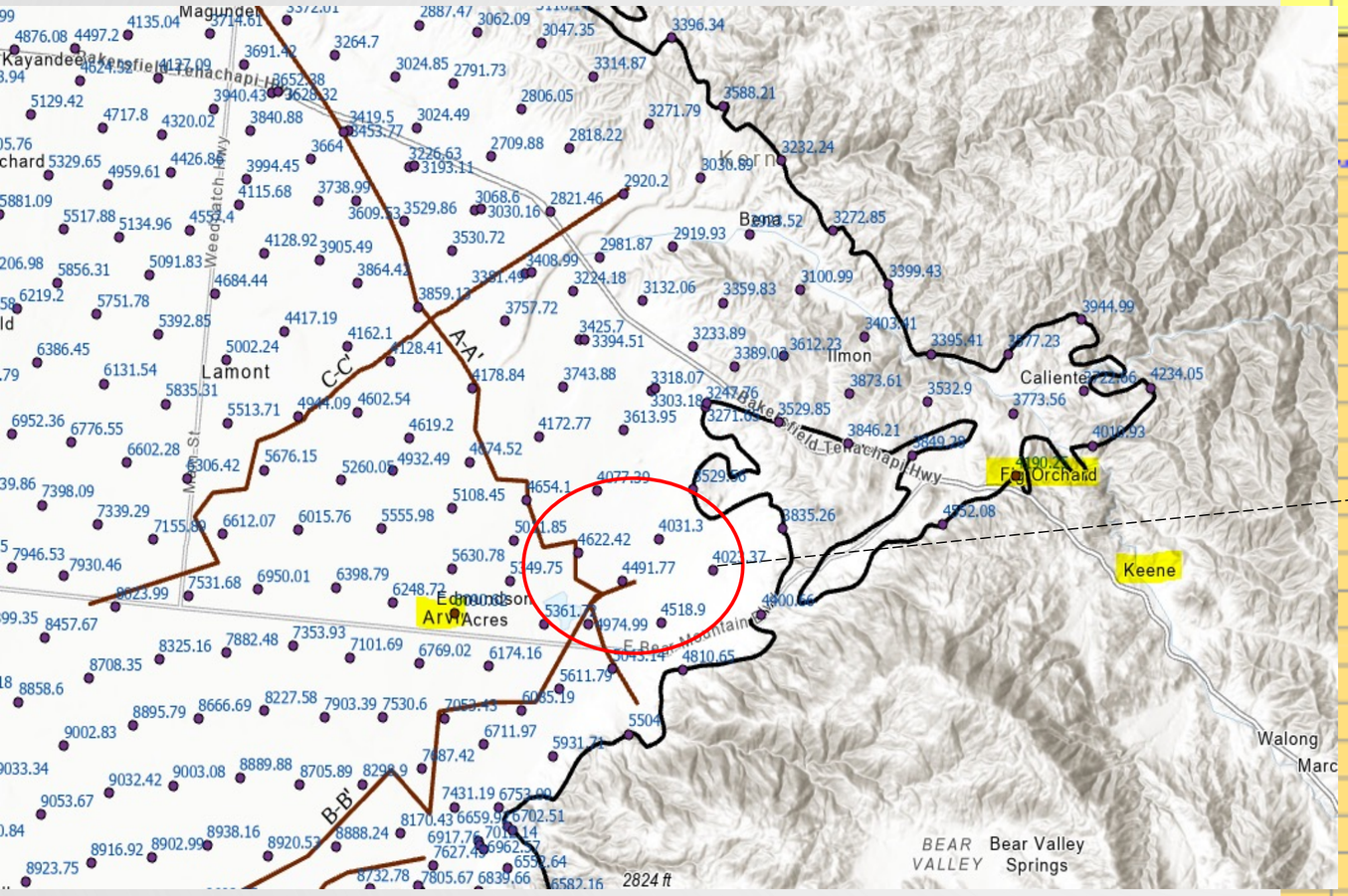
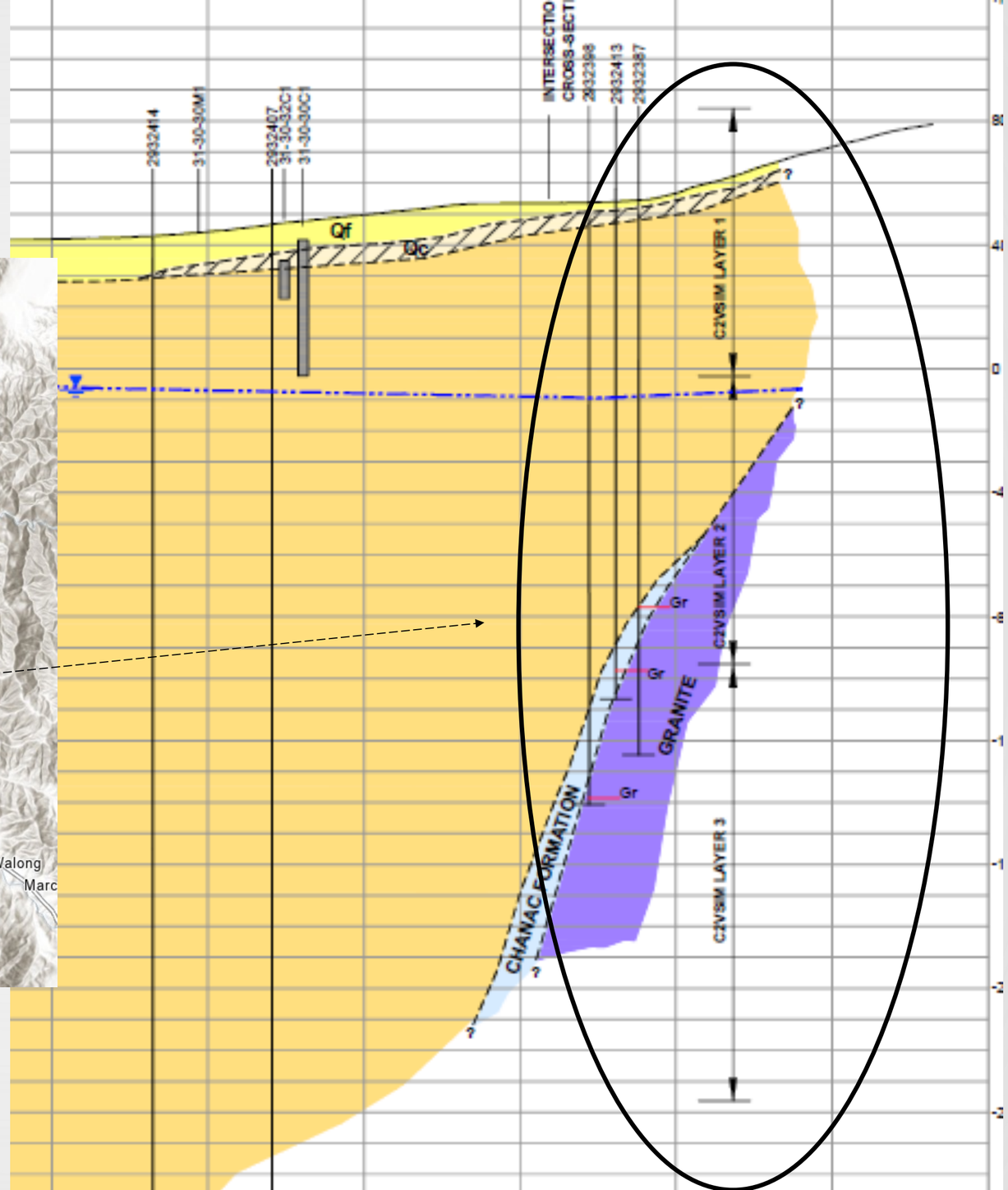
Kern County, Henry Miller Water District GPS, GEI , API: 0402970919 , x-section G-G'



CALIFORNIA DEPARTMENT OF WATER RESOURCES

Kern County, Henry Miller Water District GPS, GEI x-Section B-B'





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C2VSimFG nodes , total thickness

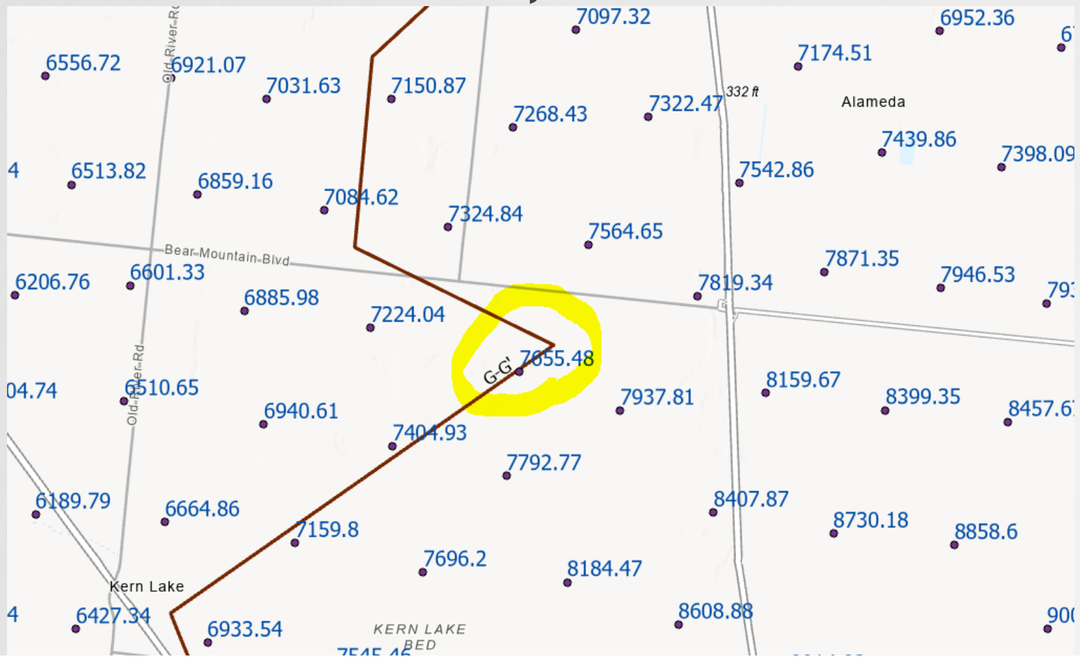
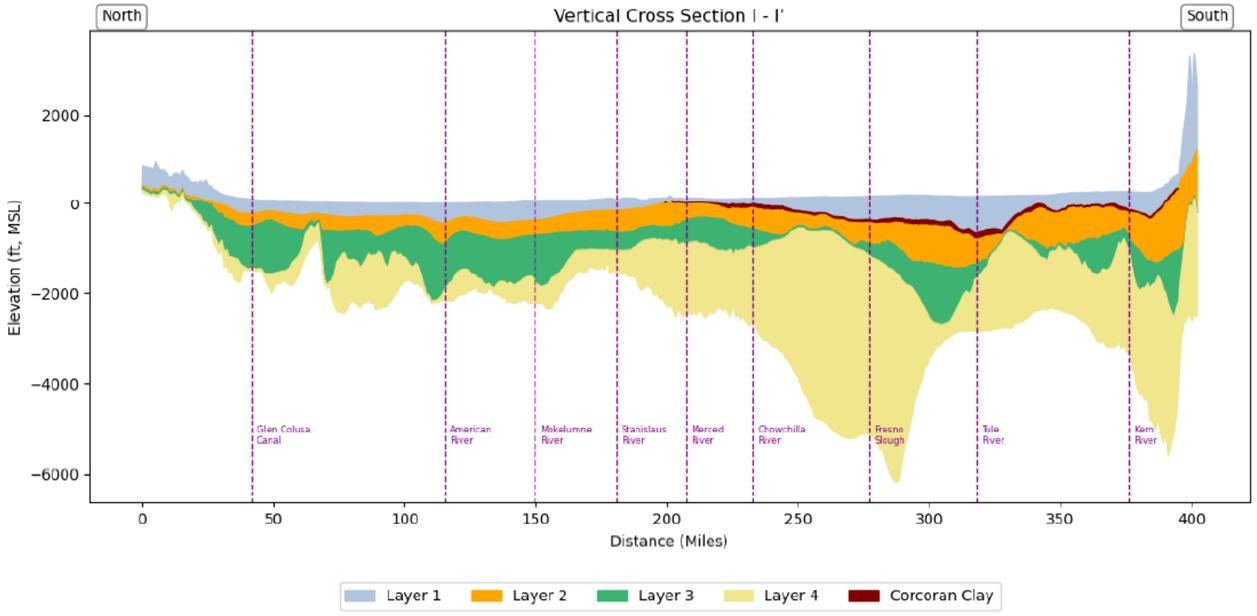
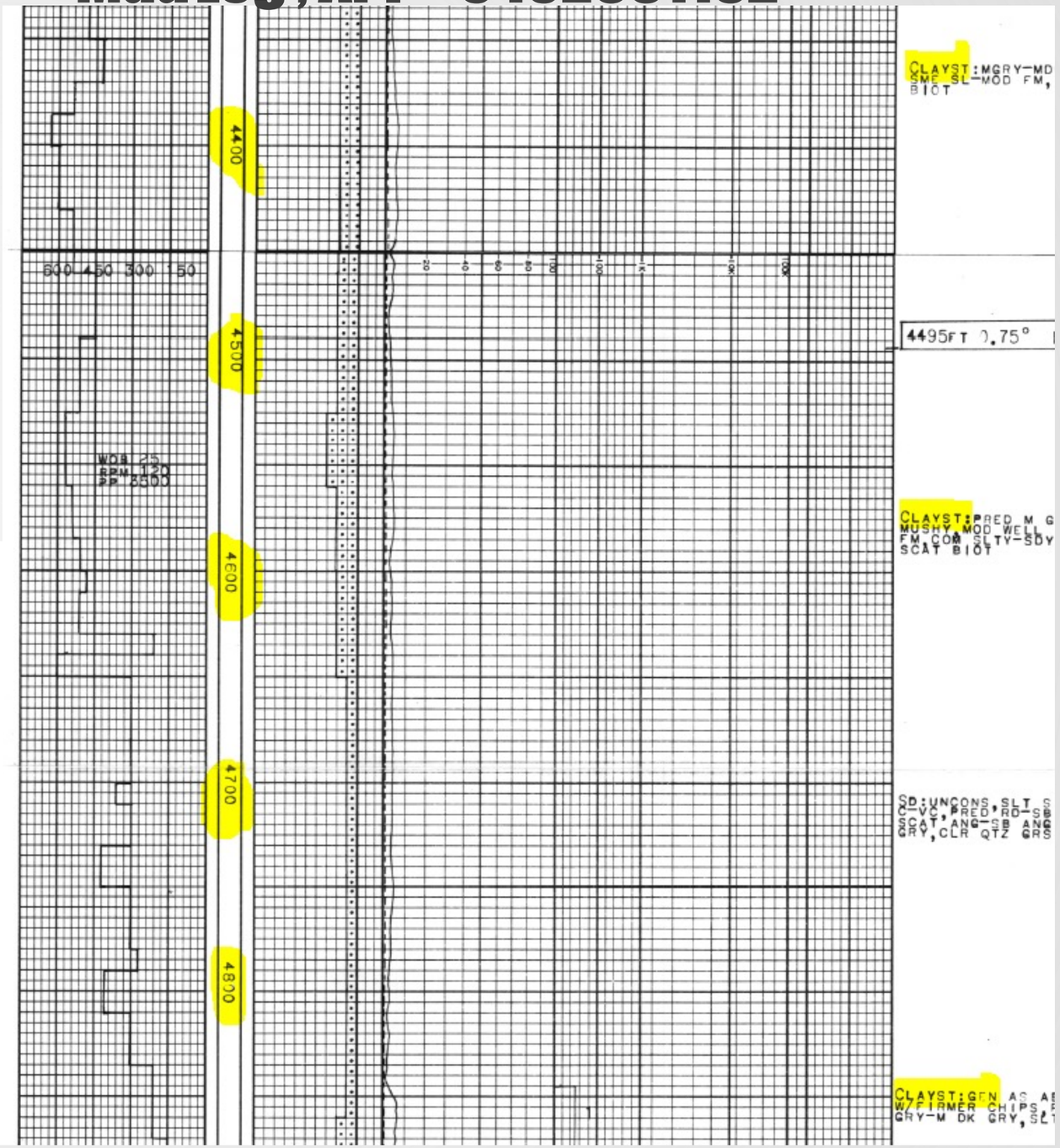
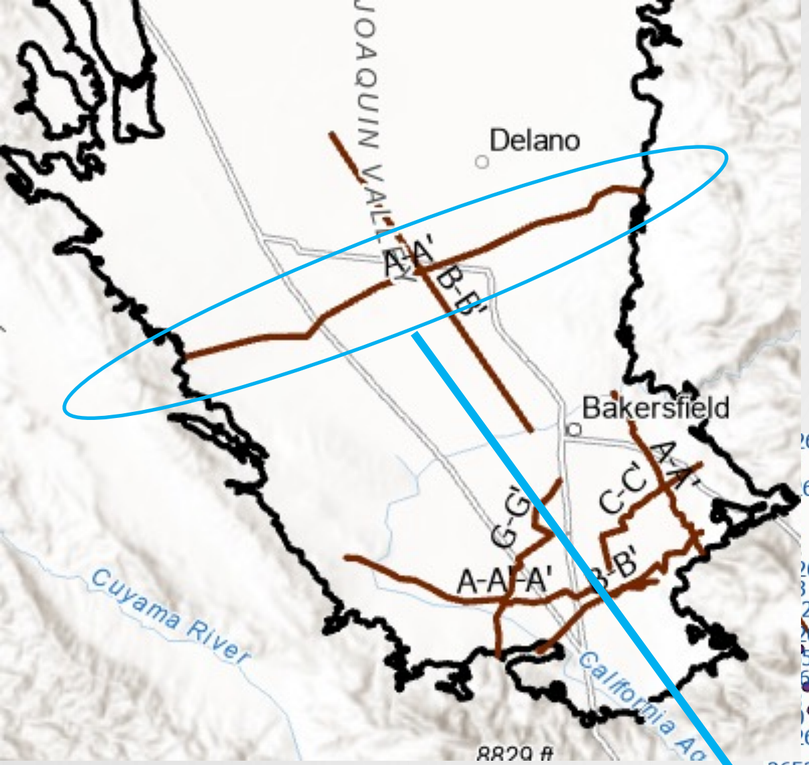


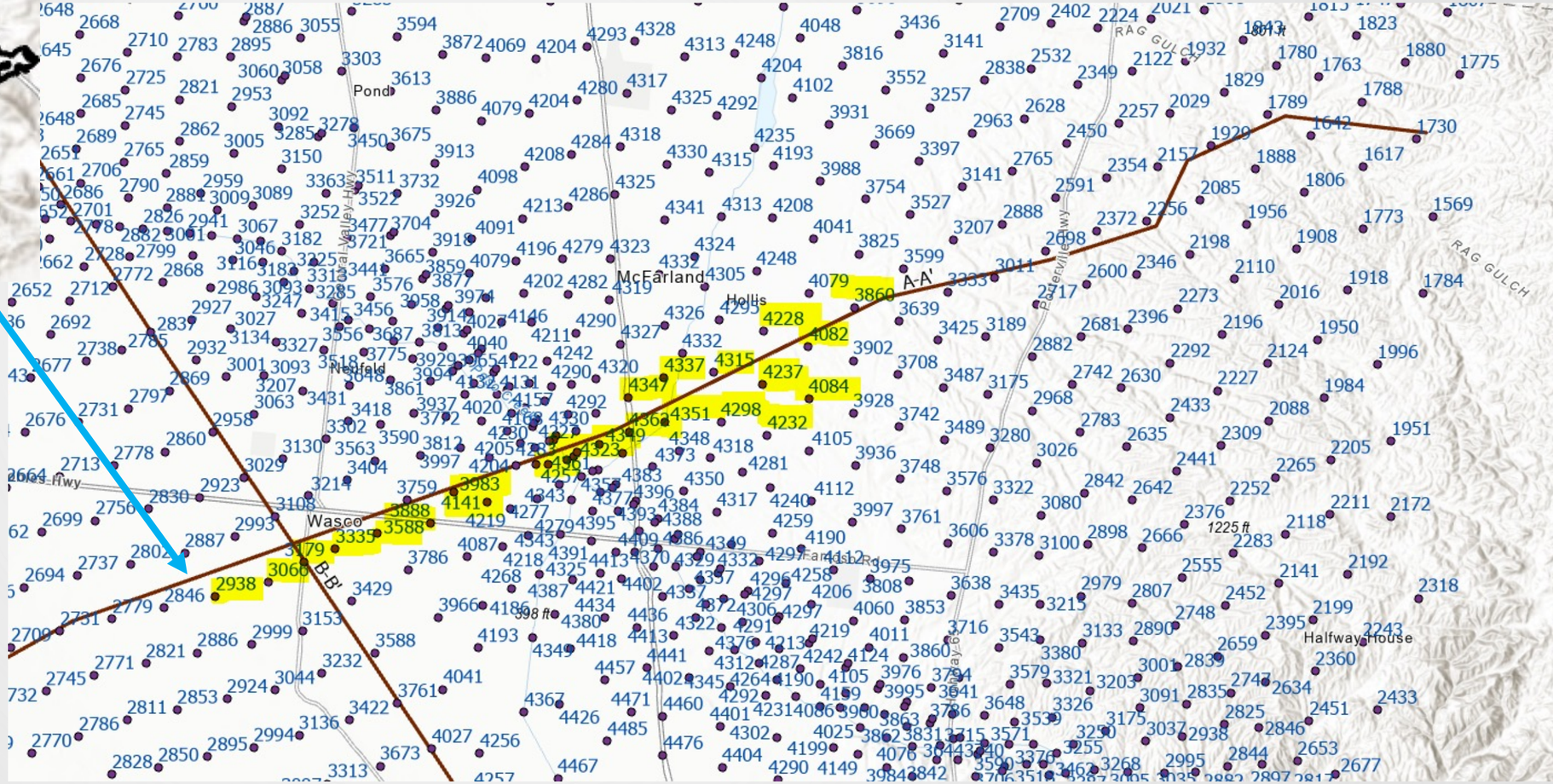
Figure 41 Cross Section I



Mud Log , API = 0402981162







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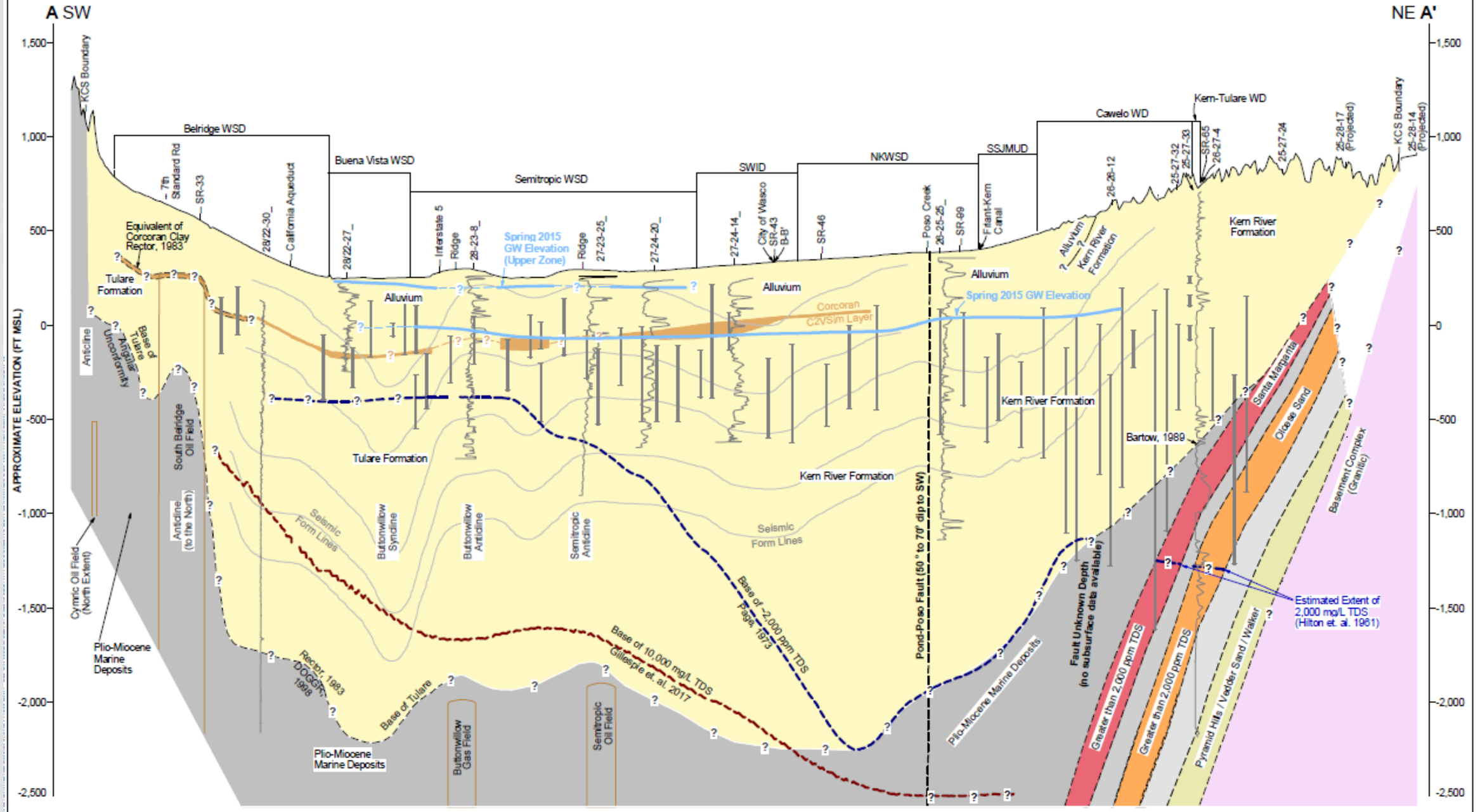


Approximate Scale
0 1.8 3.7 Miles
Vertical Exaggeration = 39x

Well Perforated Intervals
Resistivity (ohm-m)
Seismic Form Lines (PGA, 1991)
Groundwater Elevation (Spring 2015)
Corcoran Layer C2VSIM Model
Alluvium / Kern River Formation / Tulare Formation
Plio-Miocene Marine Deposits (Etchegoin/San Joaquin)
Oil Field Primacy Extents (Approximate) (DOGGR, 1998)

Kern Groundwater Authority
Basin Setting

Kern County, CA

GEI Consultants

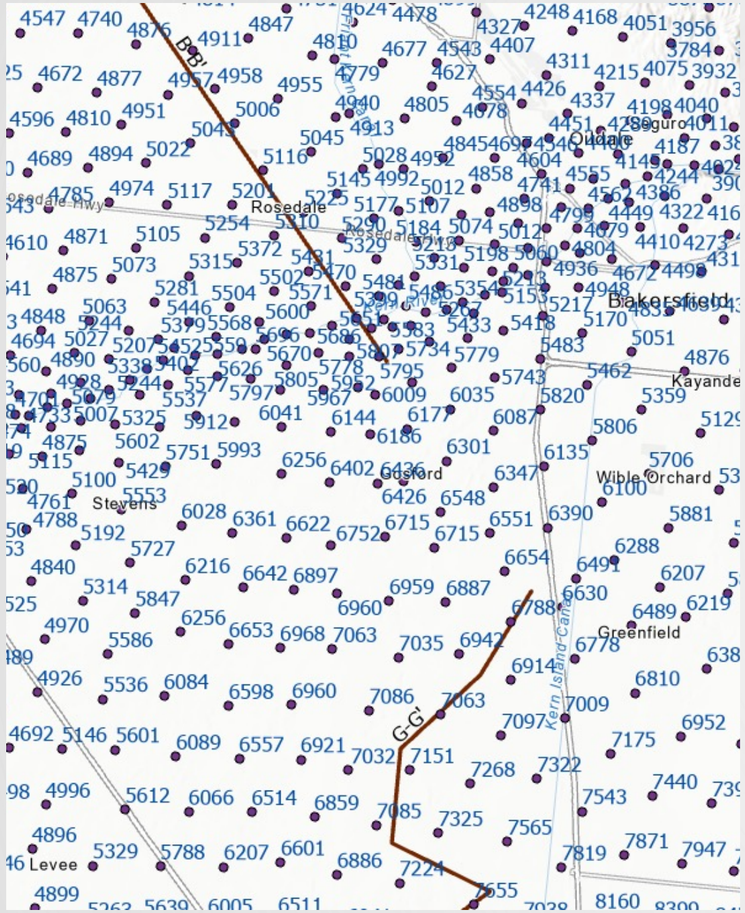
CROSS SECTION A-A' NORTH OF RIVER

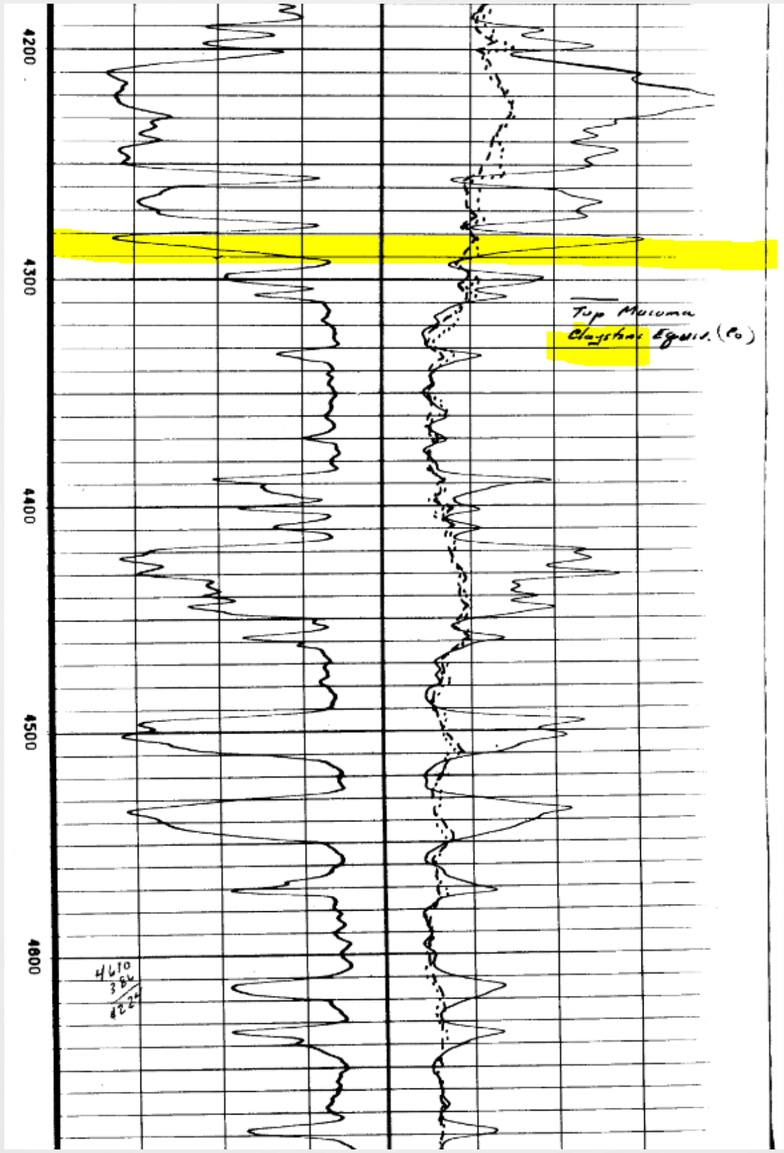
AUGUST 2019

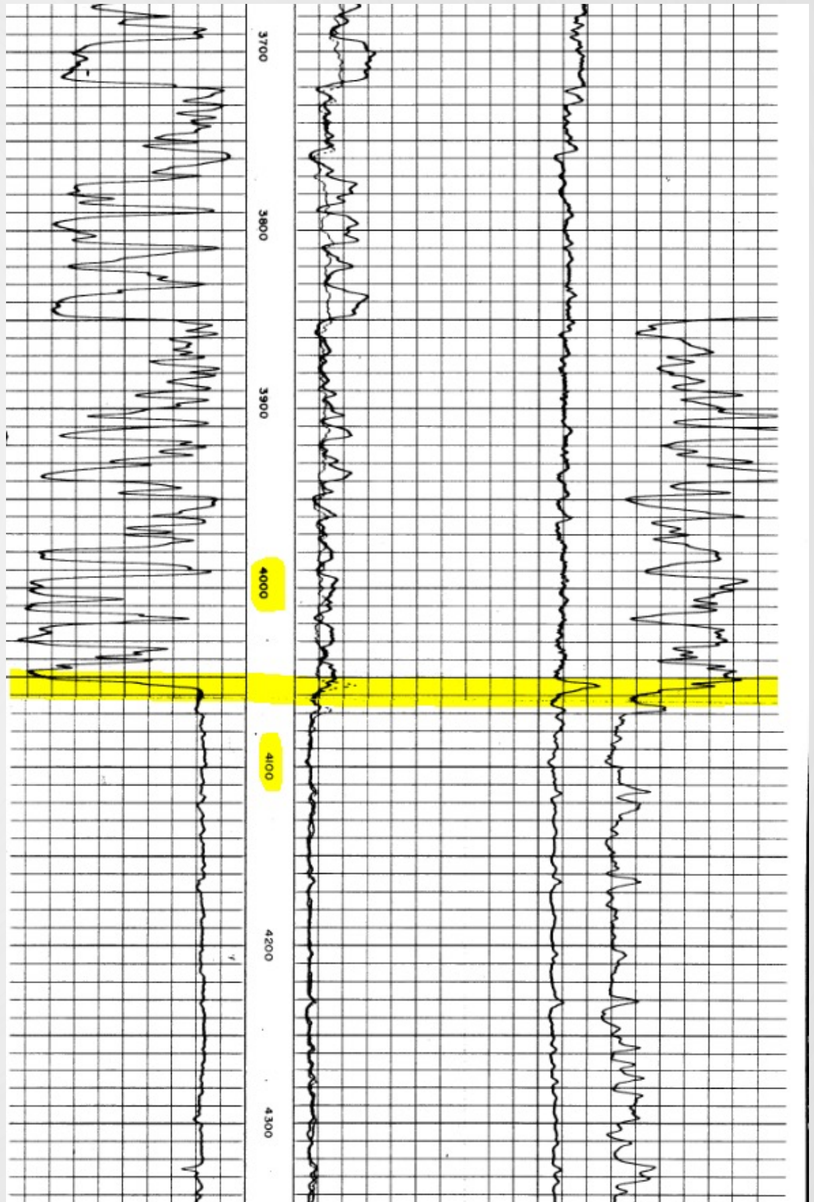
FIGURE 2-14A

Kern County, Henry Miller Water District GSP, X-Section B-B’

API: 0402932195 & API = 0402930907







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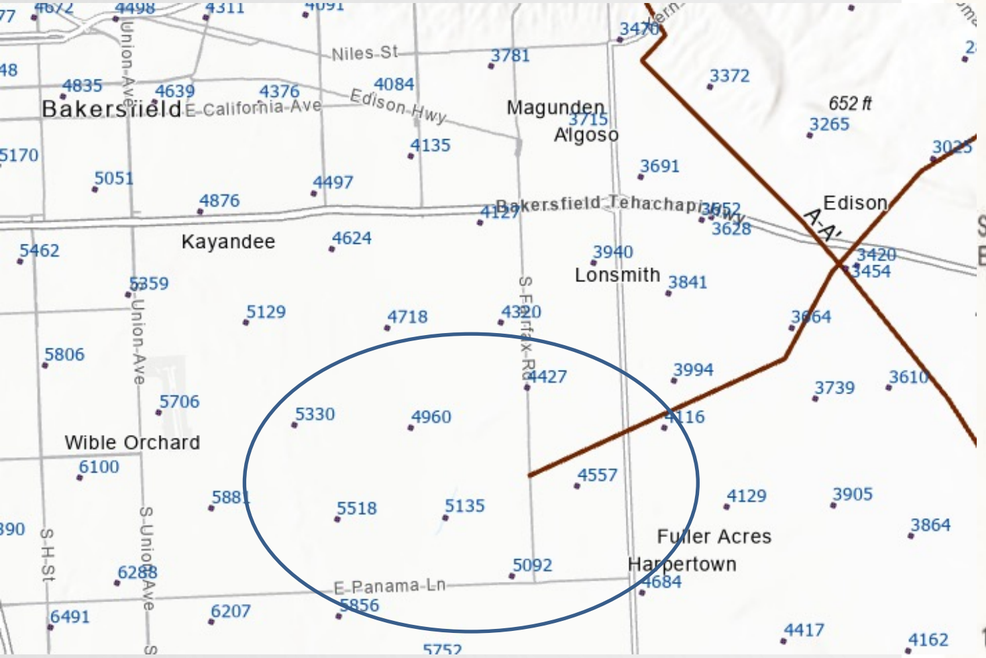

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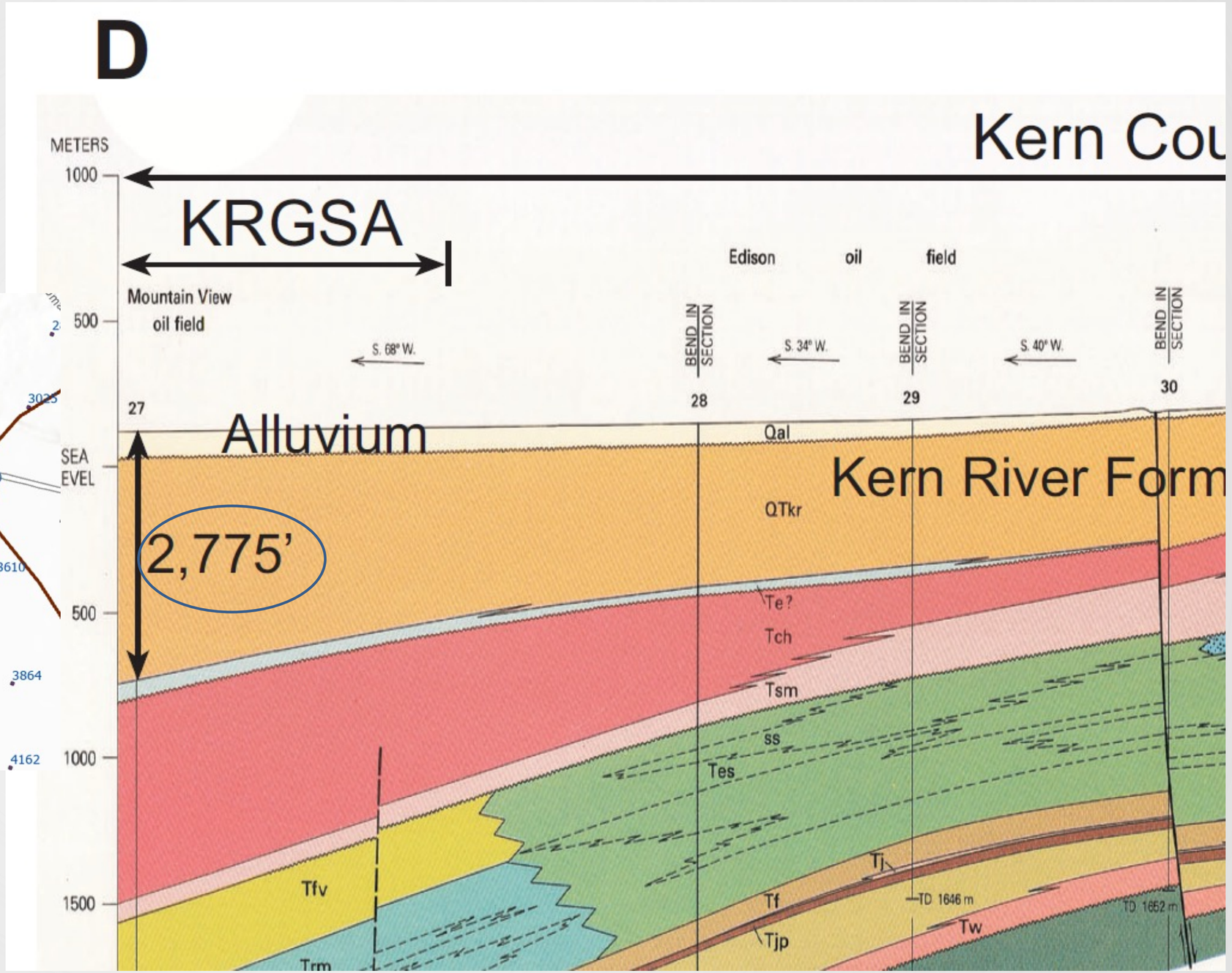

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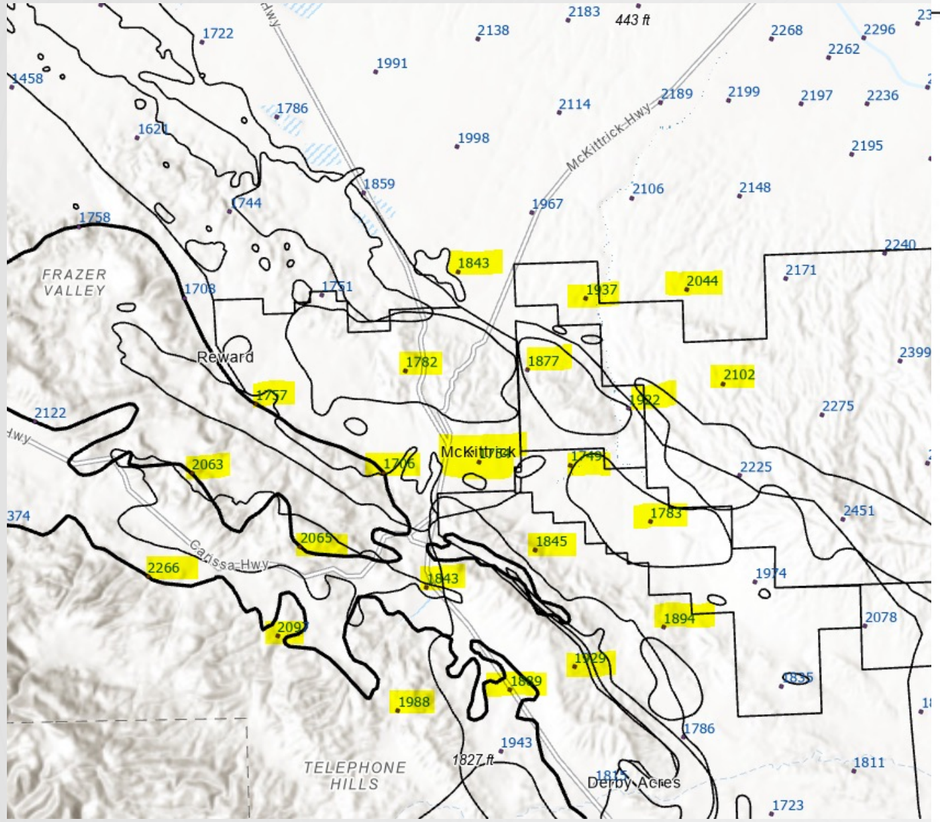
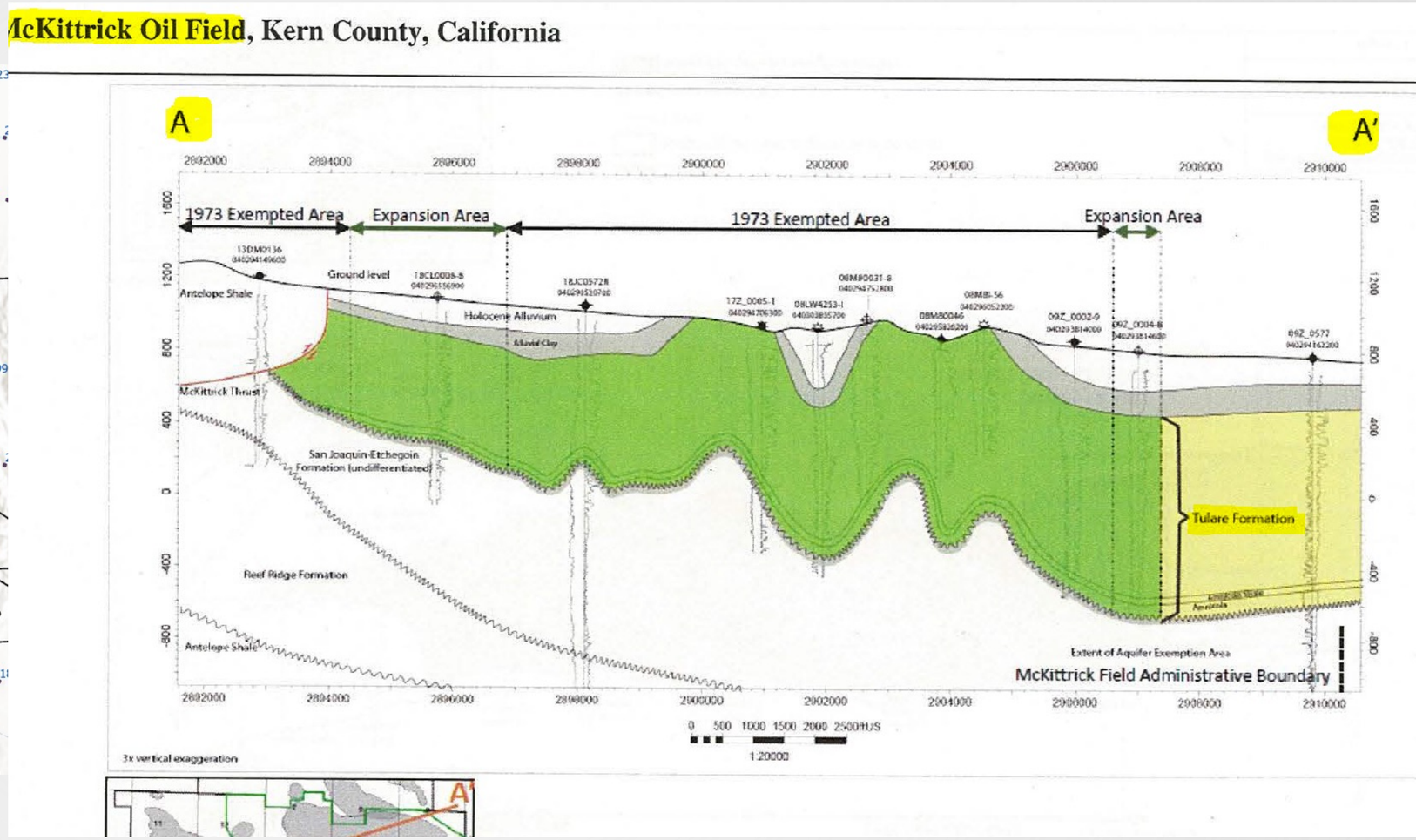
McKittrick oil Field, Aquifer exemption report, 2018





Tulare Clay and Amnicola Clay

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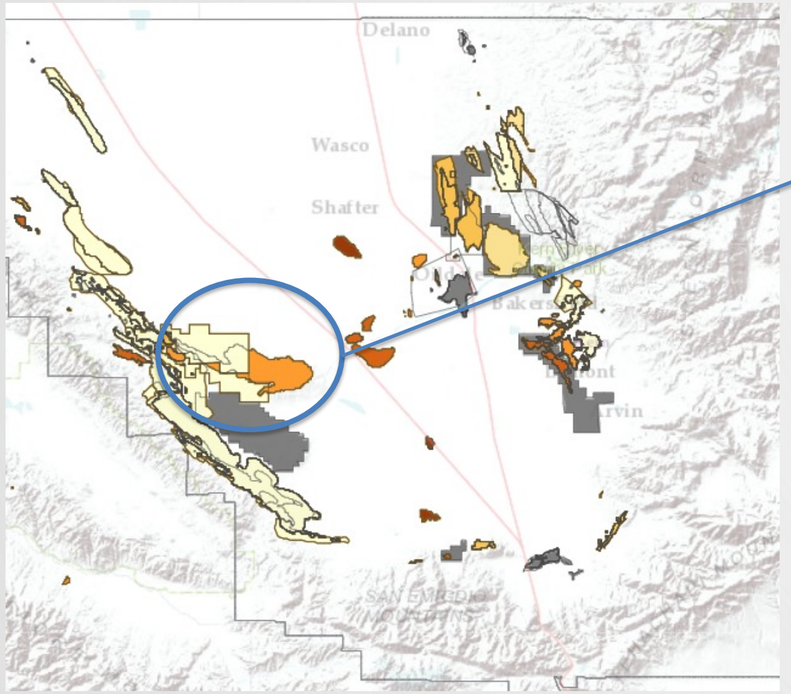
Elk Hills, Aquifer Exemption

DOC, DOGGR



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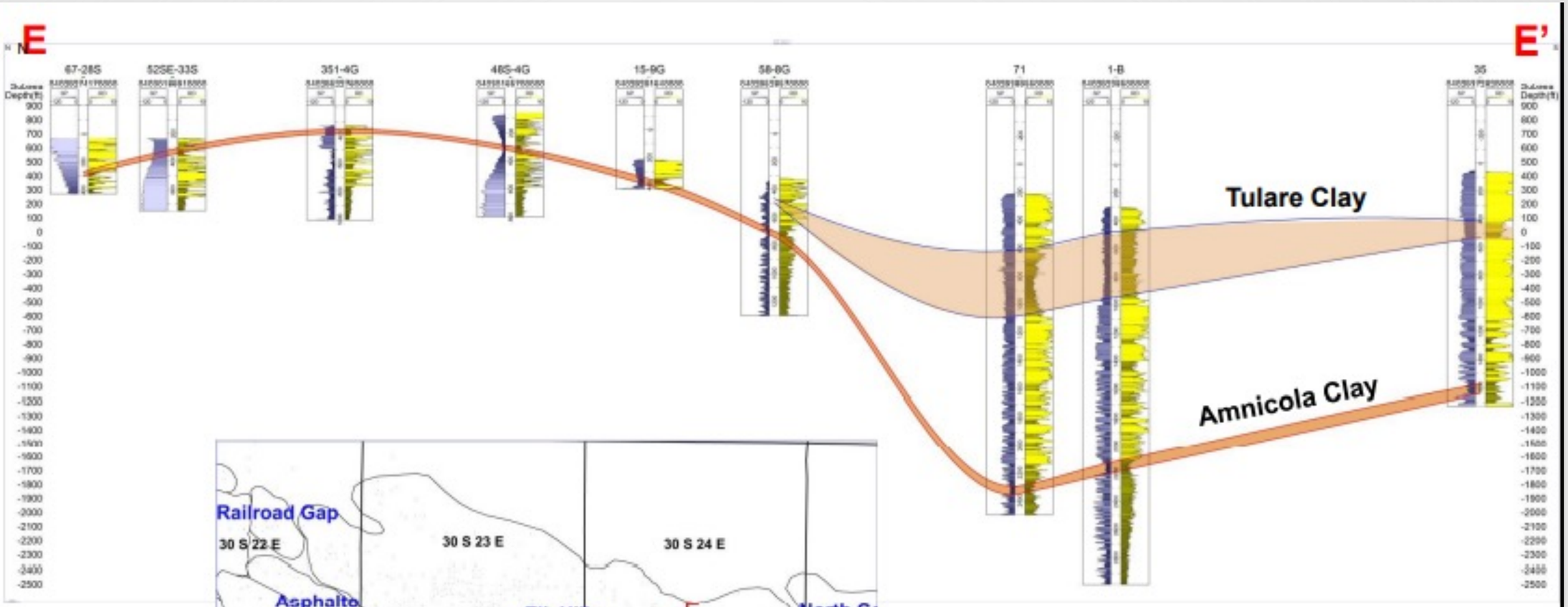
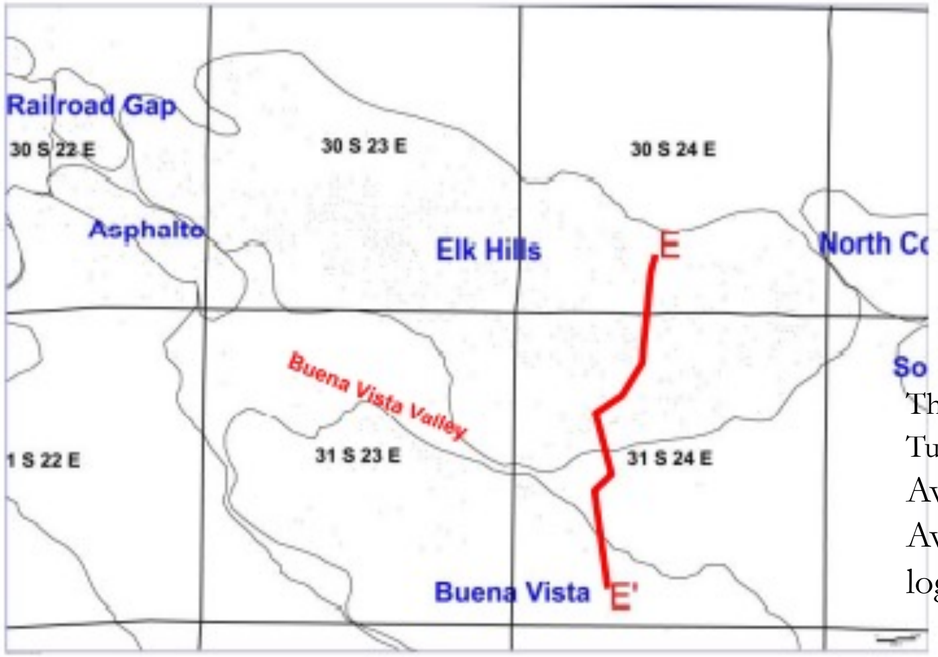
Elk Hills , Paul Bowles & Janice Gillespie 2018





The Tulare Clay is found within the upper Tulare Formation below the Corcoran Clay (0.64-0.8 Ma).

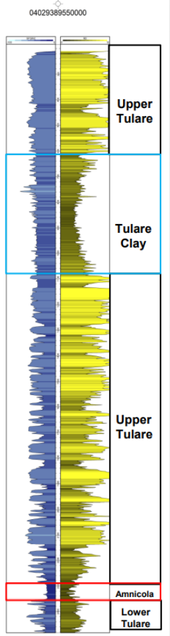
Average thickness of the Amnicola Clay =37' based on 947 wire-logs

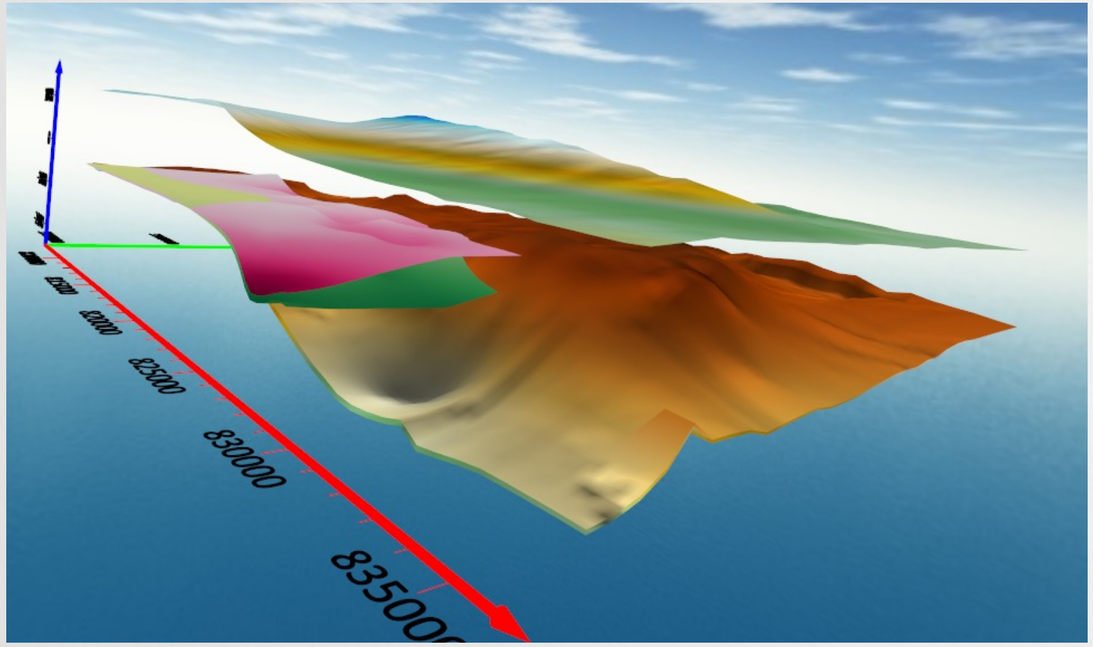
Average thickness of the Top Tulare Clay =108' based on 69 wire-logs

CALIFOR
WAT

TULARE & AMNICOLA CLAY

- Upper Tulare Formation clay referred to as the “Tulare Clay”
- Lies below Miller’s (1999) green seismic horizon dated at 0.8-0.64 Ma
- Amnicola Clay is described as an olive gray, partly calcareous/dolomitic, claystone that contains the gastropod *Amnicola*
- Separates the upper and lower sandstone and conglomerate members of the Tulare Formation
- Assumed to correlate to Miller’s (1999) orange seismic horizon dated at 2.2 Ma





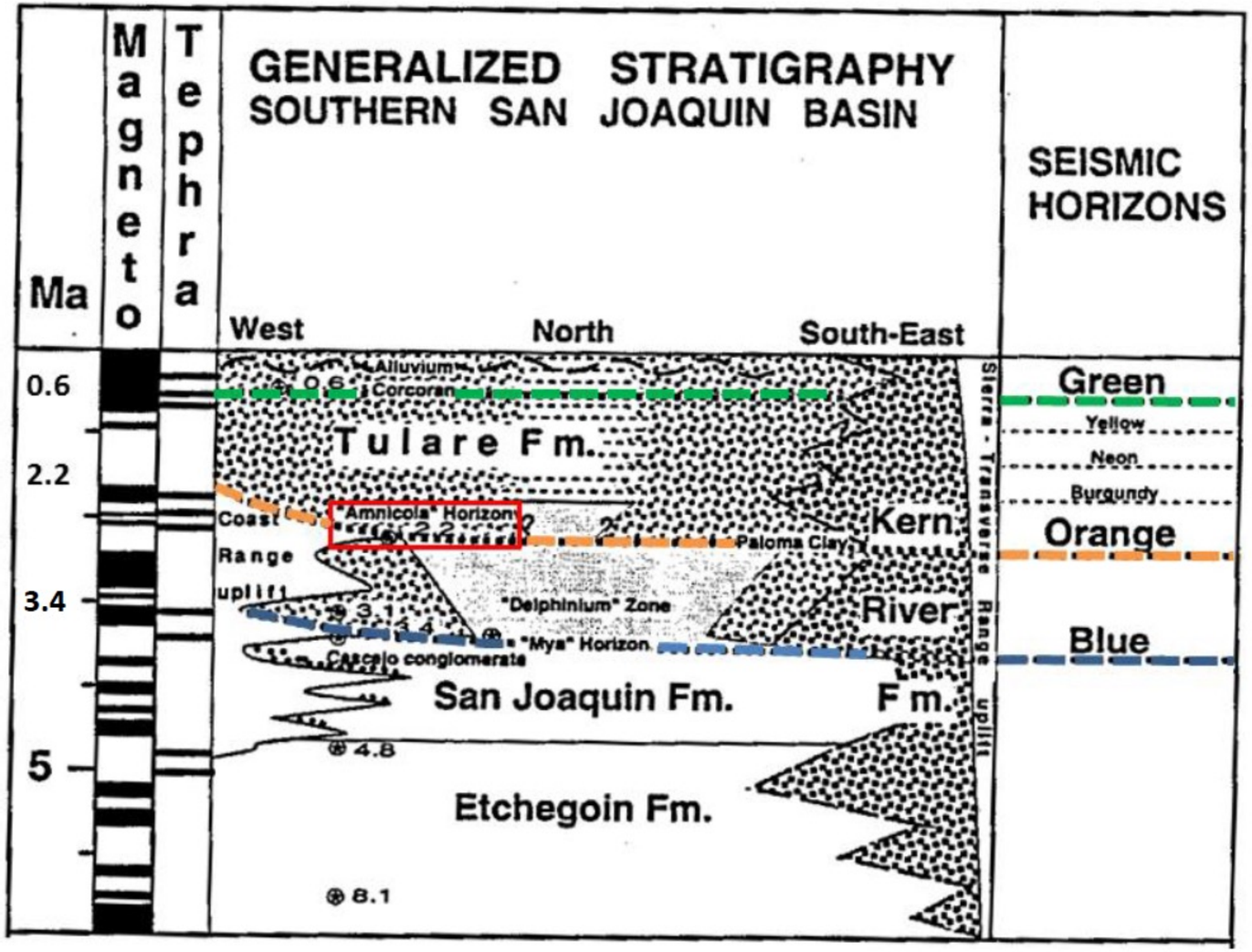


Figure 7. Generalized Stratigraphy of the Southern San Joaquin Basin with Miller’s

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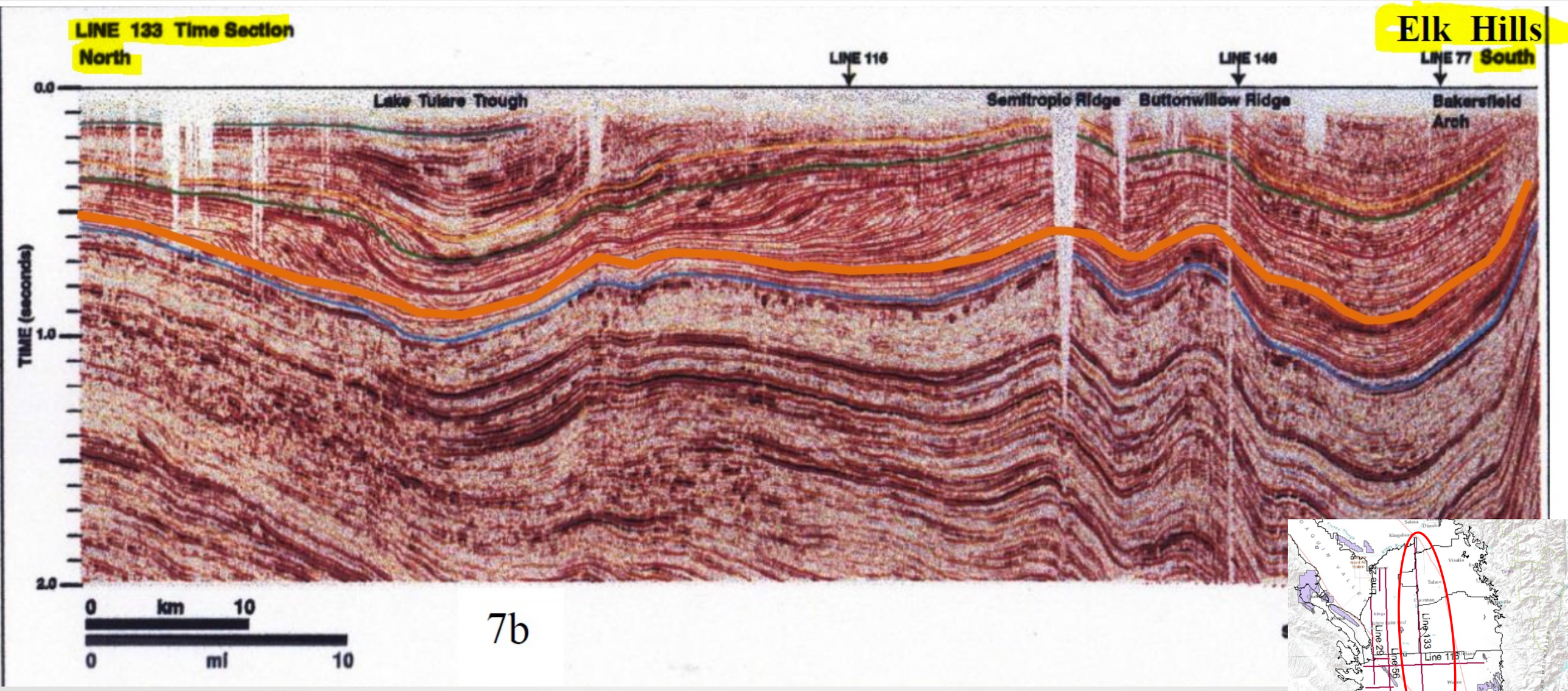

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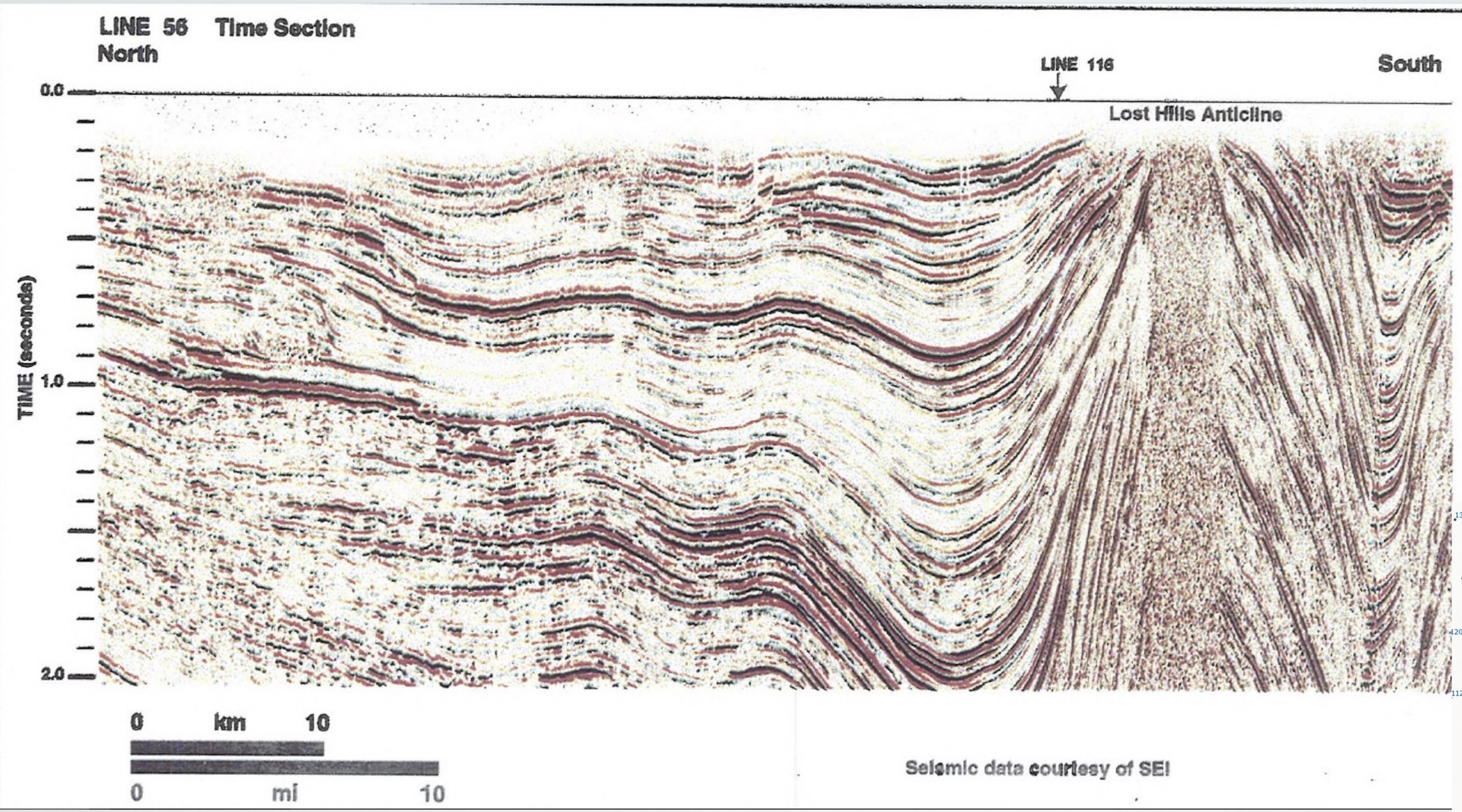
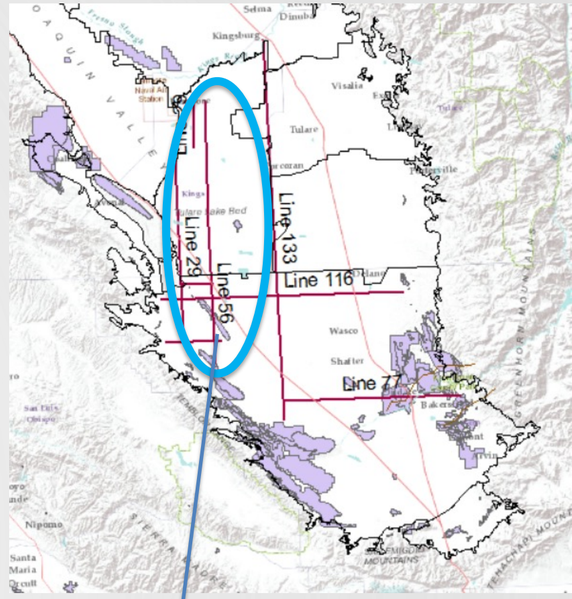
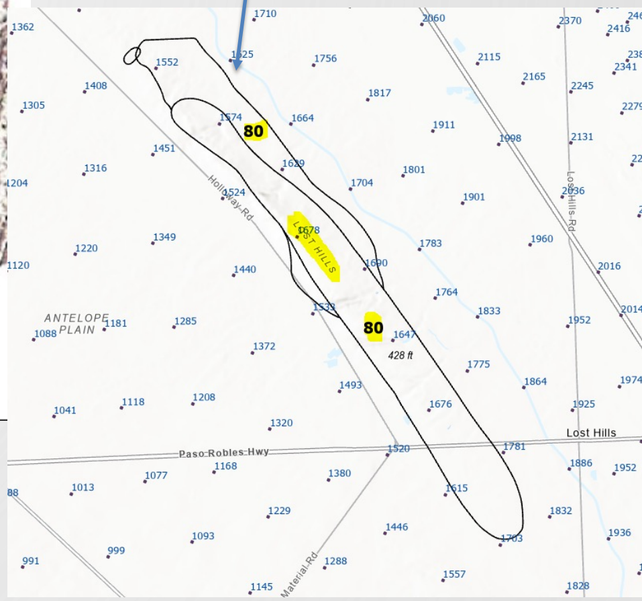
Lost Hills oil Field, Aquifer exemption report, 2019







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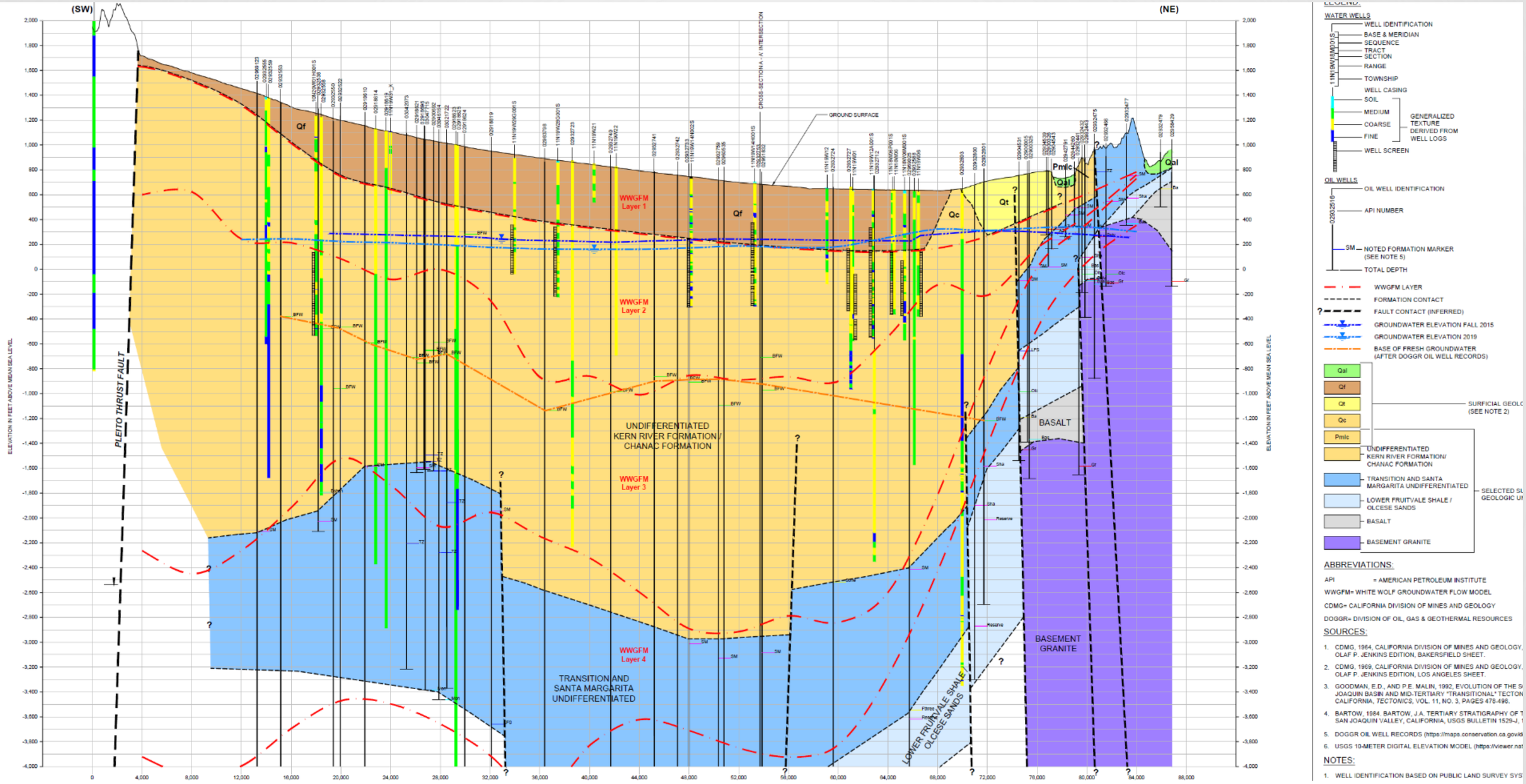
White Wolf GSP, 2022



LEGEND:

WATER WELLS

- WELL IDENTIFICATION
- BASE & MERIDIAN
- SEQUENCE
- TRACT
- SECTION
- RANGE
- TOWNSHIP

WELL CASING

- SOIL
- MEDIUM
- COARSE
- FINE

GENERALIZED TEXTURE DERIVED FROM WELL LOGS

- WELL SCREEN

OIL WELLS

- OIL WELL IDENTIFICATION
- API NUMBER
- SM — NOTED FORMATION MARKER (SEE NOTE 5)
- TOTAL DEPTH

- WWGFM LAYER
- FORMATION CONTACT
- FAULT CONTACT (INFERRED)
- GROUNDWATER ELEVATION FALL 2015
- GROUNDWATER ELEVATION 2019
- BASE OF FRESH GROUNDWATER (AFTER DOGGR OIL WELL RECORDS)

SURFICIAL GEOLOGIC (SEE NOTE 2)

- Qal
- Qf
- Qt
- Qc
- Pmlc

SELECTED SUBSURFACE GEOLOGIC UNITS

- UNDIFFERENTIATED KERN RIVER FORMATION/ CHANAC FORMATION
- TRANSITION AND SANTA MARGARITA UNDIFFERENTIATED
- LOWER FRUITVALE SHALE / OLCESE SANDS
- BASALT
- BASEMENT GRANITE

ABBREVIATIONS:

API = AMERICAN PETROLEUM INSTITUTE

WWGFM= WHITE WOLF GROUNDWATER FLOW MODEL

CDMG= CALIFORNIA DIVISION OF MINES AND GEOLOGY

DOGGR= DIVISION OF OIL, GAS & GEOTHERMAL RESOURCES

SOURCES:

1. CDMG, 1964, CALIFORNIA DIVISION OF MINES AND GEOLOGY, OLAF P. JENKINS EDITION, BAKERSFIELD SHEET.
2. CDMG, 1969, CALIFORNIA DIVISION OF MINES AND GEOLOGY, OLAF P. JENKINS EDITION, LOS ANGELES SHEET.
3. GOODMAN, E.D., AND P.E. MALIN, 1992, EVOLUTION OF THE S JOAQUIN BASIN AND MID-TERTIARY "TRANSITIONAL" TECTON CALIFORNIA, *TECTONICS*, VOL. 11, NO. 3, PAGES 478-498.
4. BARTOW, 1984. BARTOW, J.A. TERTIARY STRATIGRAPHY OF T SAN JOAQUIN VALLEY, CALIFORNIA, USGS BULLETIN 1529-J, 1
5. DOGGR OIL WELL RECORDS (https://maps.conservation.ca.gov/d
6. USGS 10-METER DIGITAL ELEVATION MODEL (https://viewer.nat

NOTES:

1. WELL IDENTIFICATION BASED ON PUBLIC LAND SURVEY SYS

Efforts accomplished & remained

GSPs / USGS reports/ Seismic / Exemption	Digitized	Visualized within GMS
North Sacramento(DWR)	yes	yes
Solano GSP	yes	
Tulare Lake GSP	yes	yes
Sutter Buttes(Steven Springhorn M.Sc. Thesis 2008)	yes	yes
Glenn-Butte AEM	yes	
PP 1401 C (USGS)	yes	
PP 1359 (USGS)	yes	
Kern GSP (USGS)	yes	
Elk Hills (Paul Bowles M.Sc. thesis 2016)	yes	
White Wolf GSP	incomplete	
Kern and Tulare Formations (Miller Ph.D. thesis 1999)		
PP 1501 (USGS)		
PP 1529 D (USGS)		
Chowchilla GSP		
Colusa GSP		
Corning GSP		
Cosumnes GSP		

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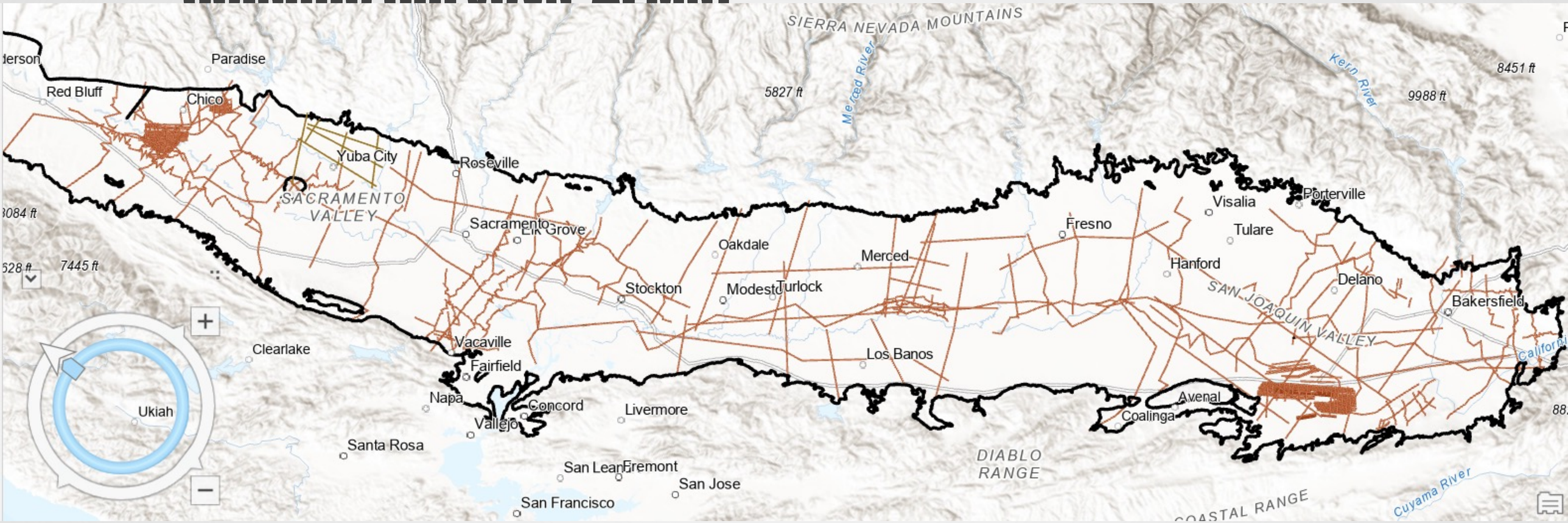
WATER RES

GSP / USGS rep/…	Digitized	Visualized within GMS
Delta Mendota GSP		
East Contra Costa GSP		
East San Joaquin GSP		
Kaweah GSP		
Kings GSP		
Madera GSP		
Merced GSP		
Modesto GSP		
North American GSP		
Tracy GSP		
Turlock GSP		
Olcese GSP		
Poso Creek oil field Aquifer exemption		
McKittrick oil field Aquifer exemption		
Lost Hills oil field Aquifer exemption		

Overlay of all profiles (GSPs, Aquifer Exemptions, Seismic Surveys, AEMs)



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Acknowledgments:
Kyle Hardage
Thi Pham
Tyler Hatch

Contact Email :
Behrooz.Etebari@water.ca.gov

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