Kern River Groundwater Sustainability Agency (KRGSA)

Hydrogeologic Conceptual Model and Groundwater Conditions

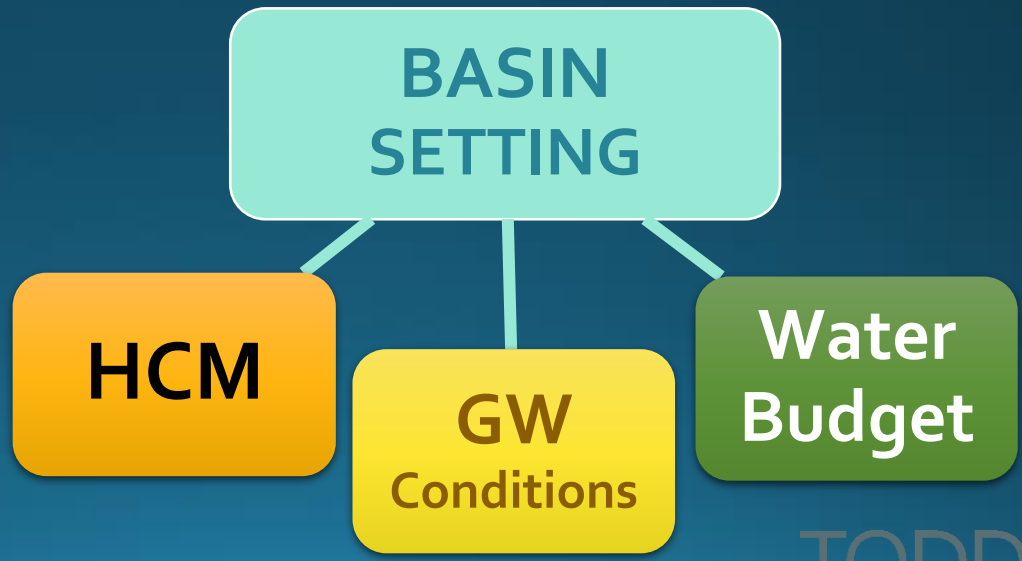
Groundwater Sustainability Plan (GSP)

April 5, 2018

TODD GROUNDWATER

Workshop Presentation

- Groundwater Sustainability Plan (GSP) Requirements
- Hydrogeologic Conceptual Model (HCM)
- Groundwater Conditions
- Next Steps



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GSP Overview

Data Compilation / Data Management System

Institutional Setting – Water Supply / Plan Area

Workshop → Hydrogeologic Conceptual Model / Groundwater

Water Budget (Current and Historical)

Hydrogeologic Conceptual Model, Groundwater Conditions, and Water Budgets collectively inform the Sustainability Analysis

Sustainability Goals and Criteria

Management Scenarios Projected Water Budget

Monitoring Networks Plan Development

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Hydrogeologic Conceptual Model Regulatory Requirements

What does the groundwater basin look like?

- Physical Setting
  - Topography
  - Geologic and structural setting
  - Surface geology, soils
  - Hydrology
- Groundwater Basin and Aquifers
  - Basin geometry, lateral boundaries and bottom
  - Principal aquifers and aquitards and properties
  - Stratigraphic and structural changes

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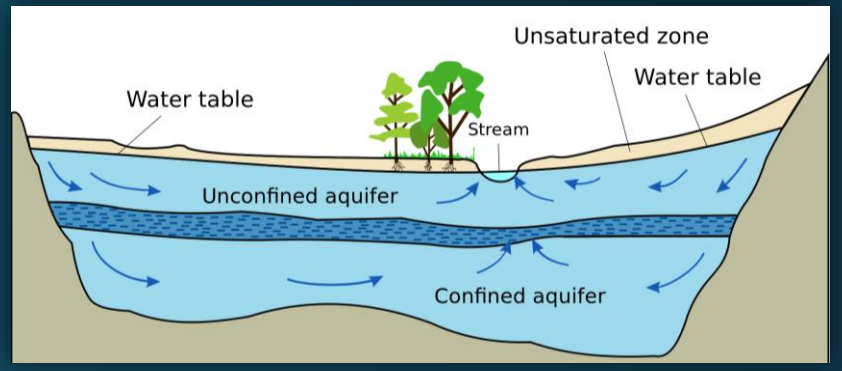
Groundwater Conditions Regulatory Requirements



What are the current and historical groundwater conditions?

- Hydrographs (changes in groundwater levels over time)
- Groundwater elevation contour maps
- Changes in groundwater in storage (between seasonal highs)
- Groundwater quality
- Land subsidence
- Groundwater Dependent Ecosystems (if applicable)

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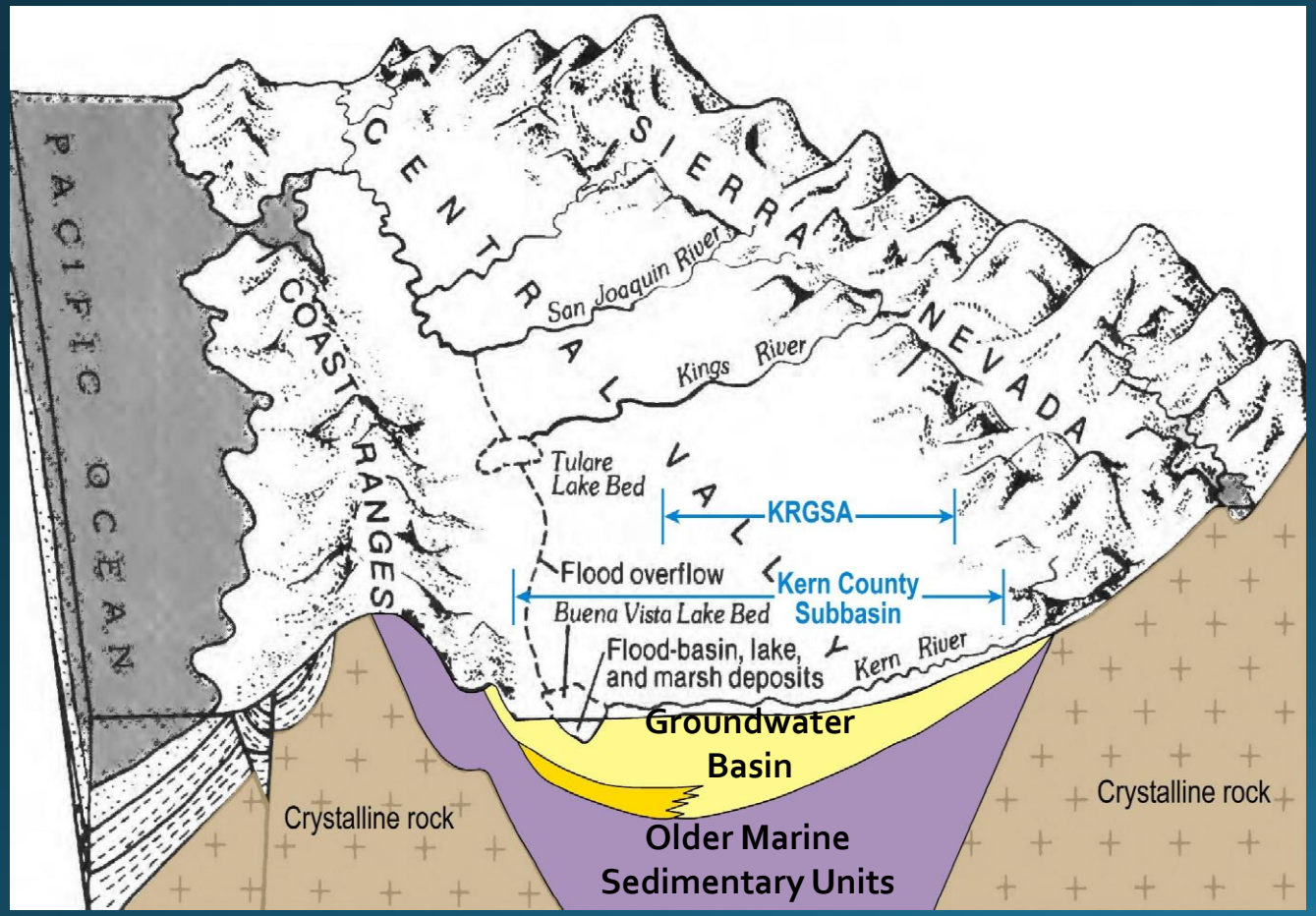
Conceptual Hydrogeologic Setting
Kern County Subbasin



- Alluvial-filled trough between the Sierra Nevada and Coast Ranges
- Underlain by older marine sedimentary units
- Flanked by crystalline bedrock

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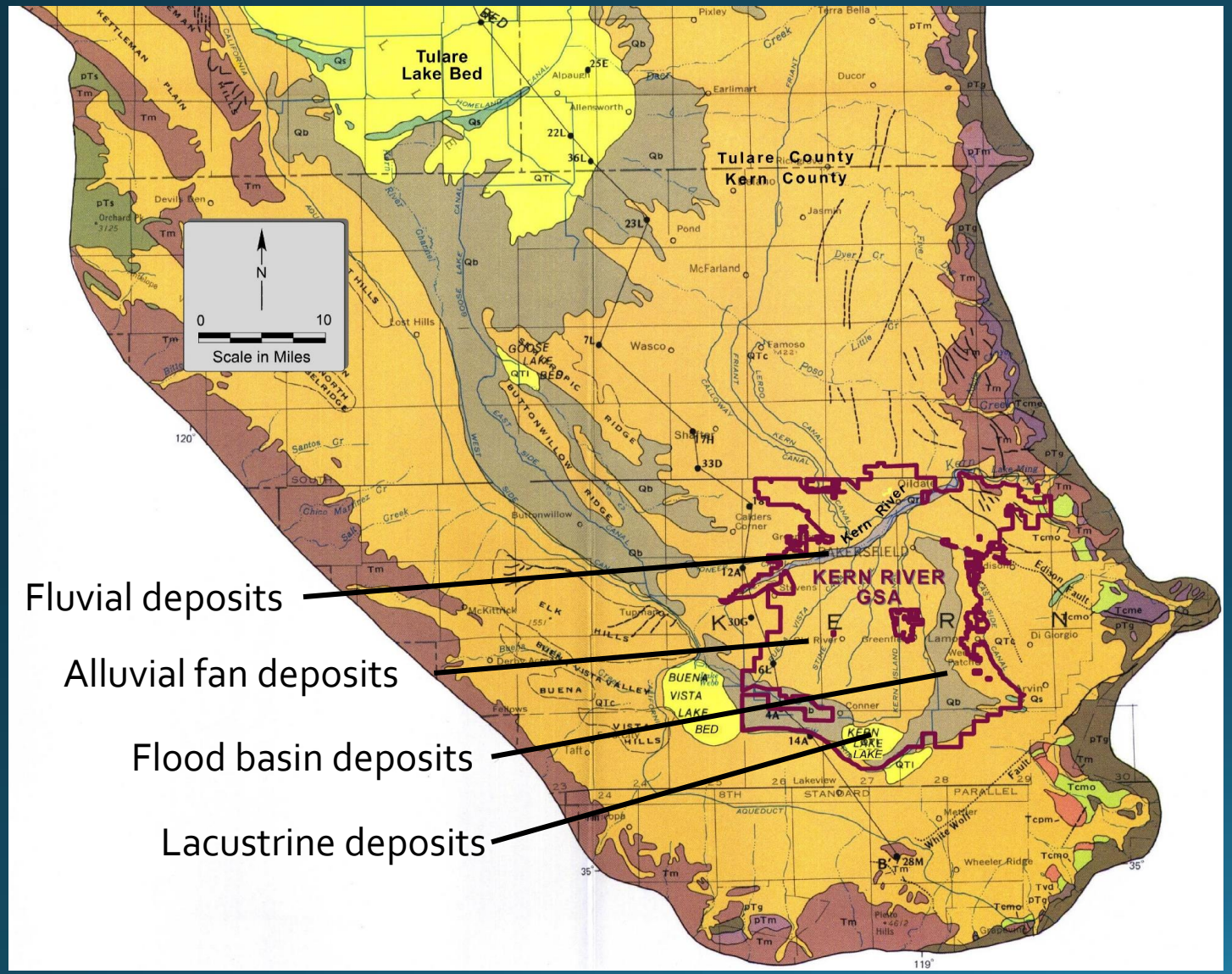
Regional Geology and Depositional Environments



- Coarse-grain fluvial deposits along the Kern River in the KRGSA
- Coarse-grain alluvial fan
- Fine-grain flood basin deposits along fan edges
- Fine-grain lacustrine deposits in the old lake beds

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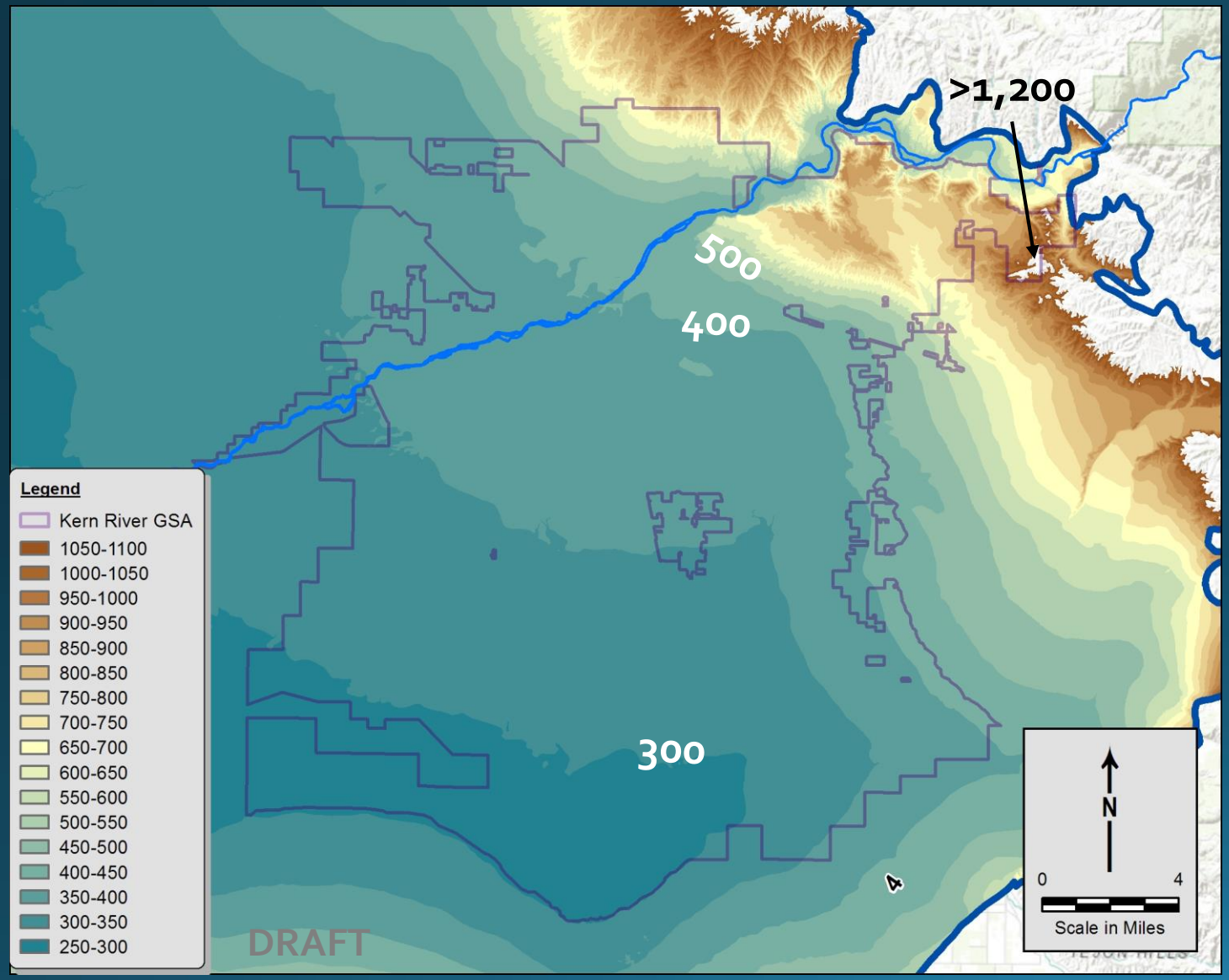
Ground Surface Elevations - KRGSA



- Ground surface elevations vary >900 feet over the KRGSA
- Highest elevation in the northeast > 1,200 ft msl
- Lowest elevation in the south of about 280 ft msl
- Most of the KRGSA between 300 ft msl and 400 ft msl

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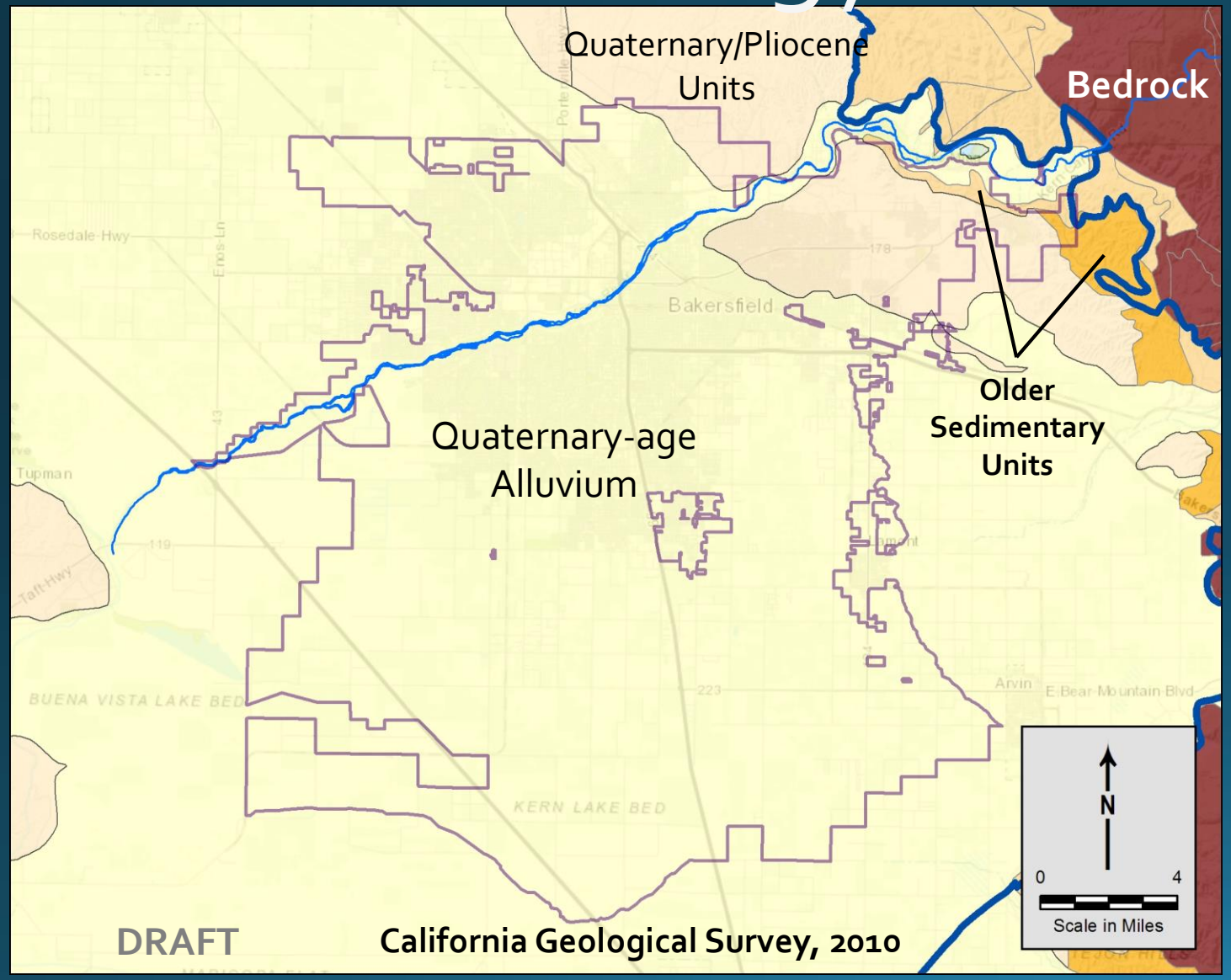
Surface Geology – Statewide Maps



- KRGSA mostly overlain by Quaternary age alluvial deposits
- Rimmed by older units on the northwest in upper surface elevations
- Quaternary- and Pliocene-age units begin around 500 feet msl
- Miocene units at higher elevations (above about 800 ft msl)

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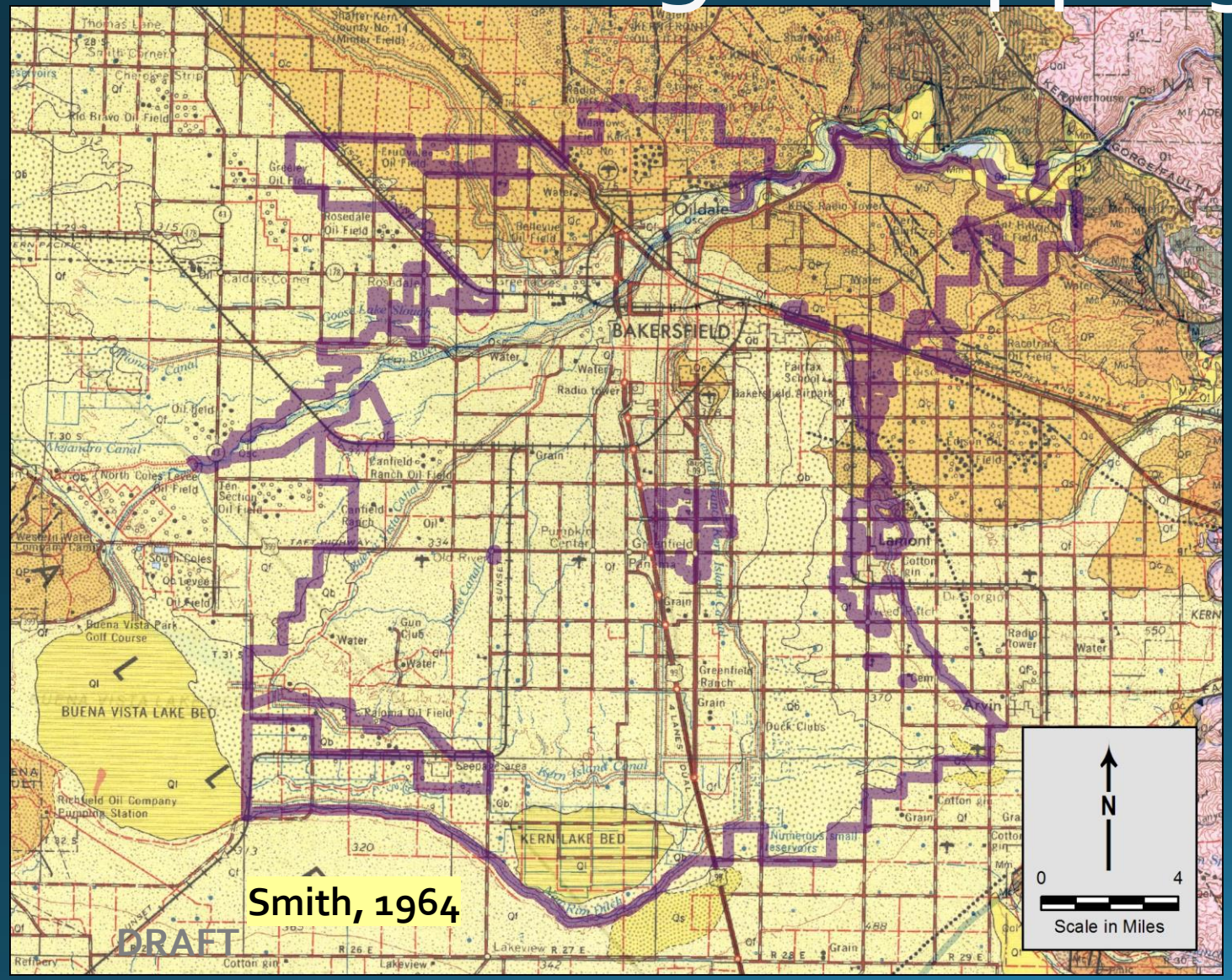
Local Geologic Mapping



- Older local geologic maps provide more detail in the northeast
- Local maps for the Bakersfield Quadrangle compiled by Division of Mines and Geology 1964
- Contain structural information required by GSP regulations such as geologic faults and folds

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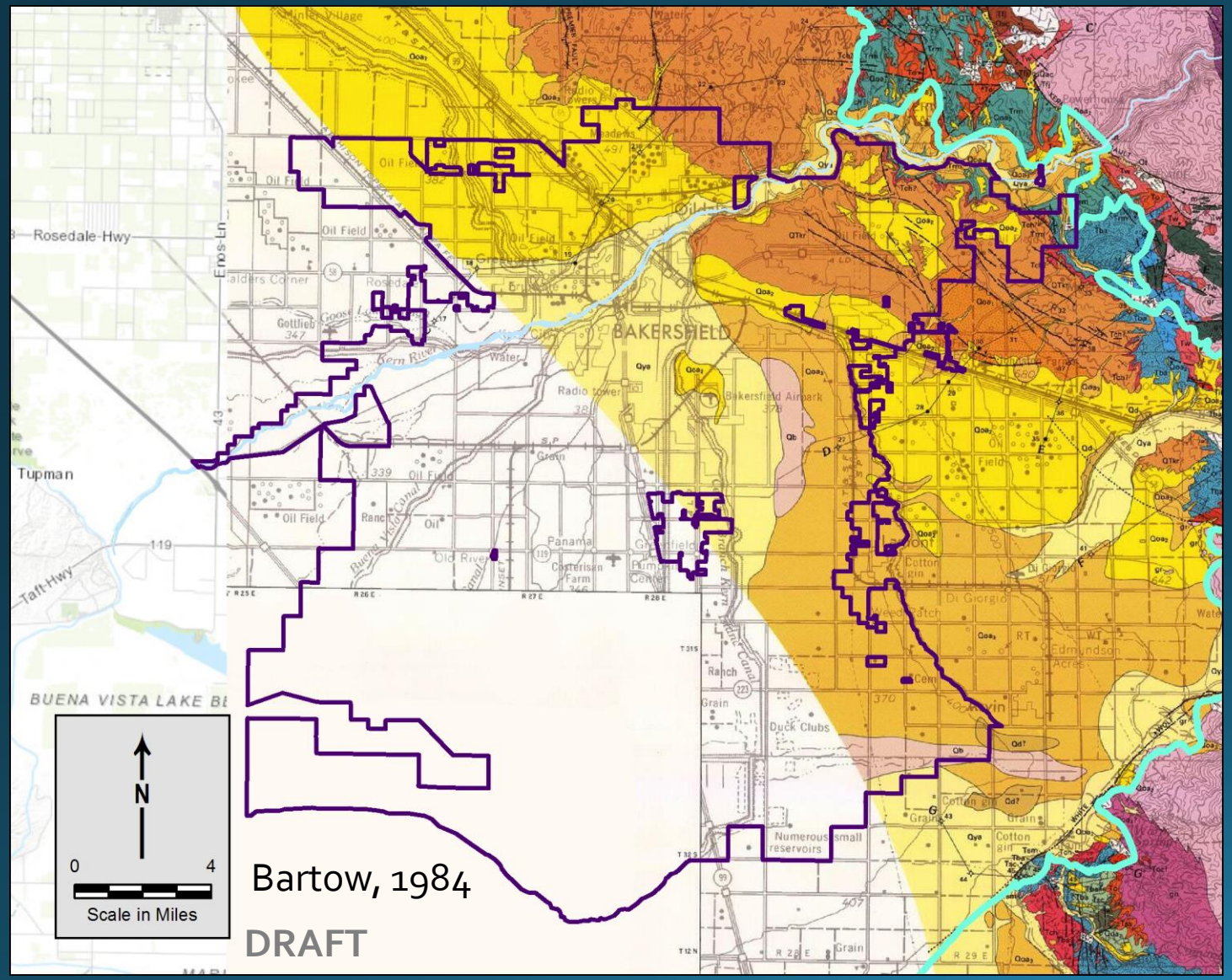
Additional USGS Geology Map



- Additional compilation and modifications provided by USGS, 1984
- Focus on the Tertiary geology
- General agreement with other maps with additional modifications

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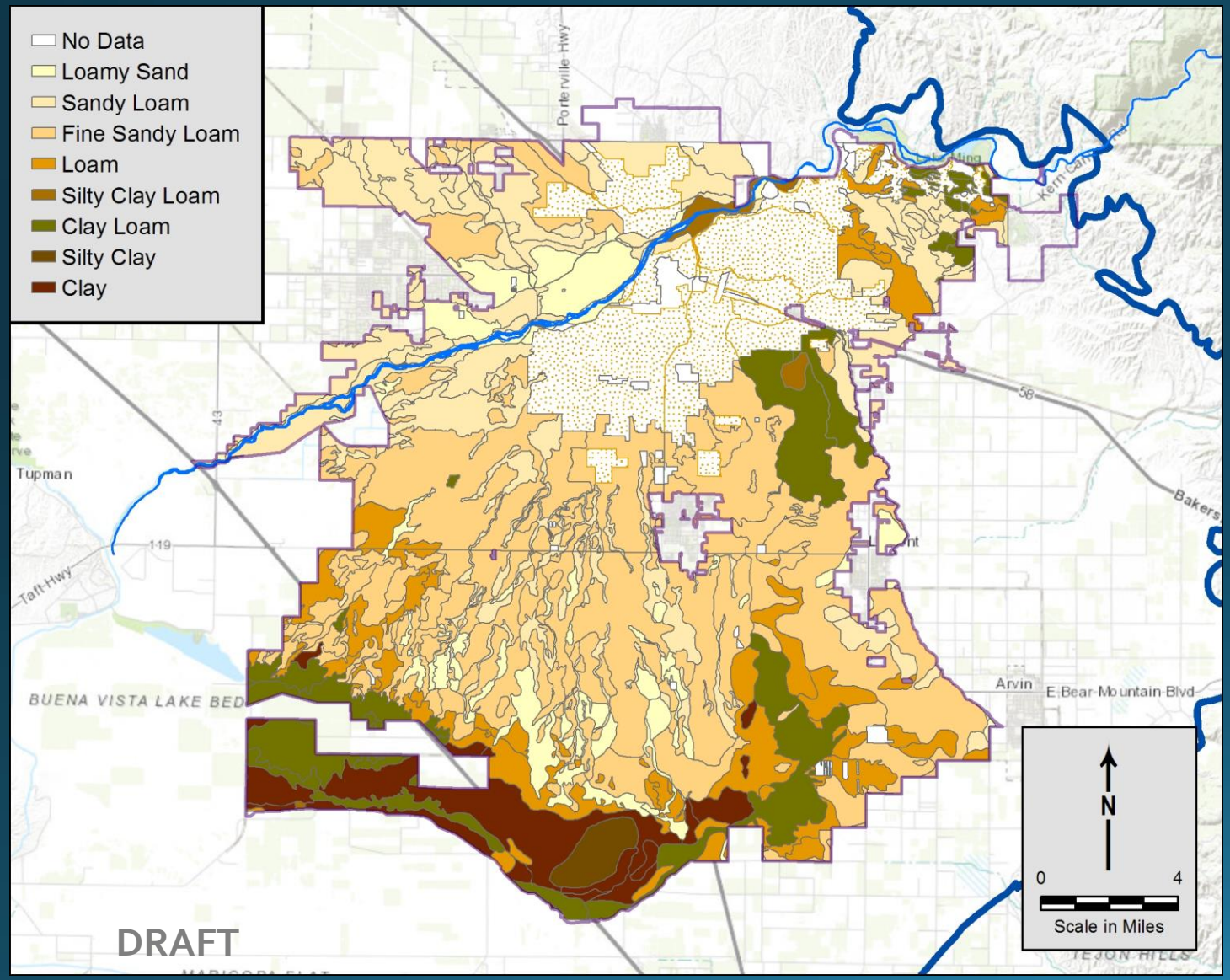
Soil Textures



- More permeable textures indicated by lighter colors (white, yellow, light orange)
- Lower permeability textures indicated by dark orange, green and brown
- Soil textures agree well with geologic framework

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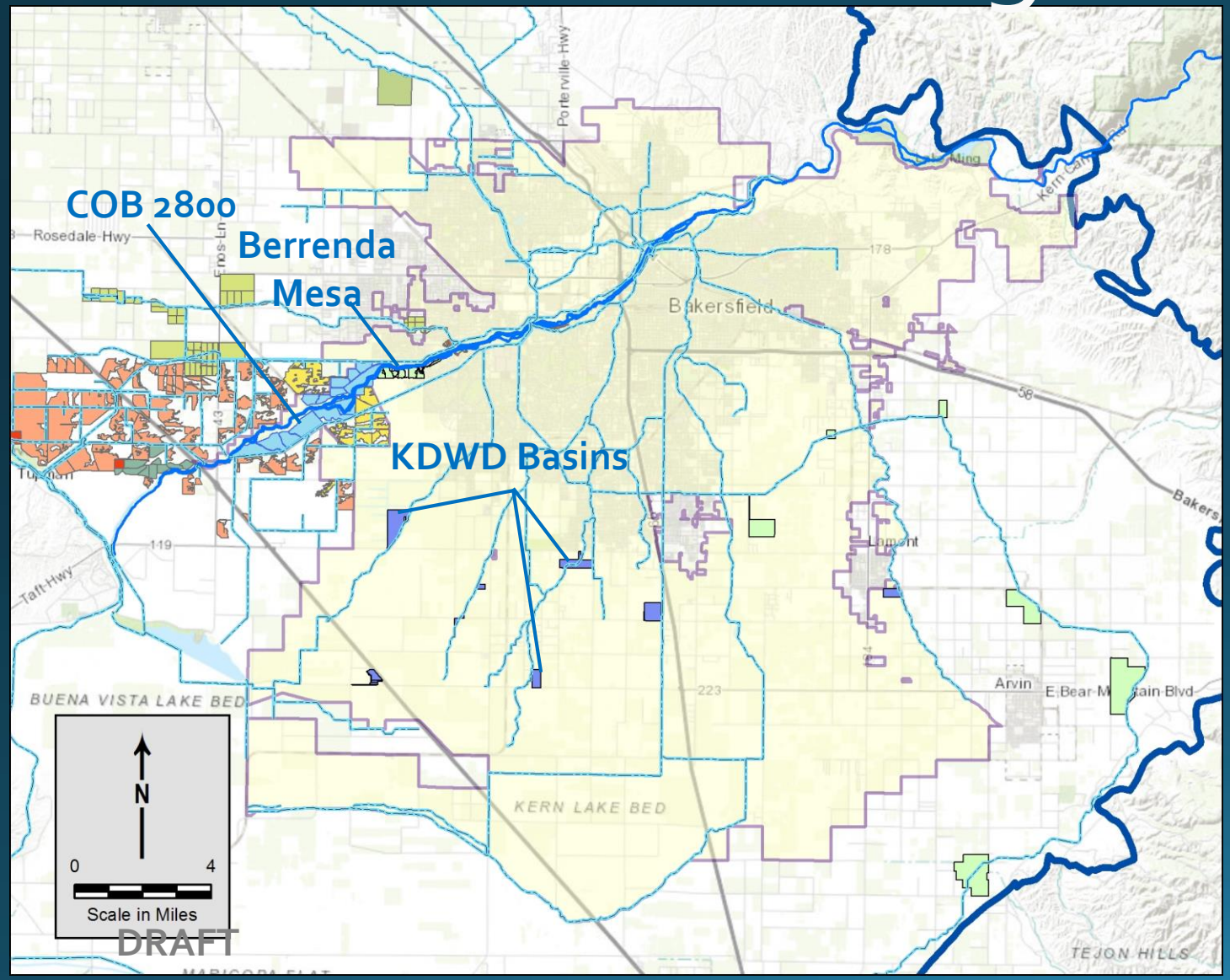
Canals and Recharge Basins



- Managed recharge in river channel, unlined canals, and basins
- KRGSA groundwater banking projects:
  - COB 2800 Acres
  - KCWA Berrenda Mesa
  - KDWD Metropolitan Project
- Numerous additional banking projects nearby

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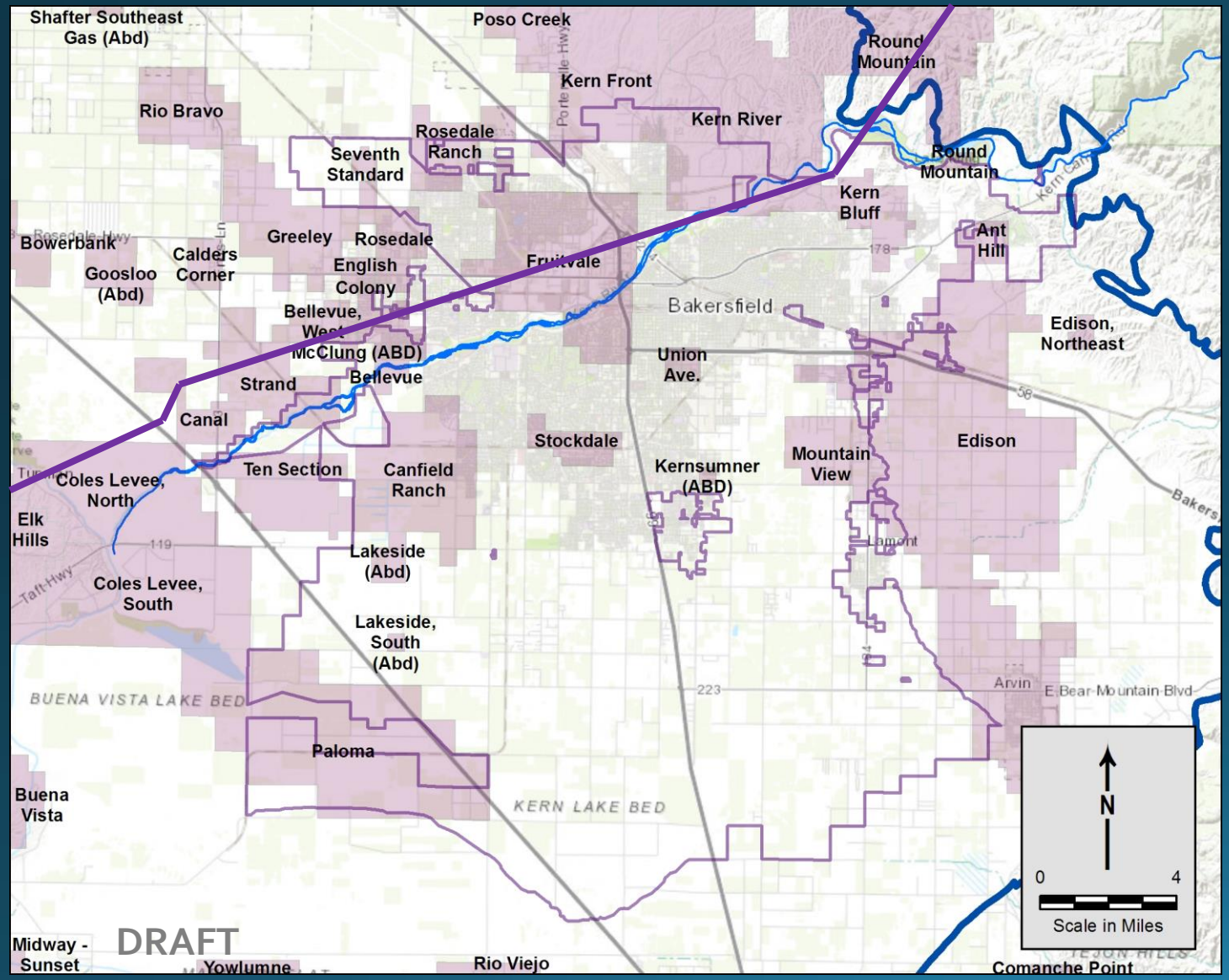
Oilfields in Vicinity of KRGSA



- KRGSA underlain by numerous oilfields at depth
- Cross section through northern GSA illustrates relationship to the groundwater basin

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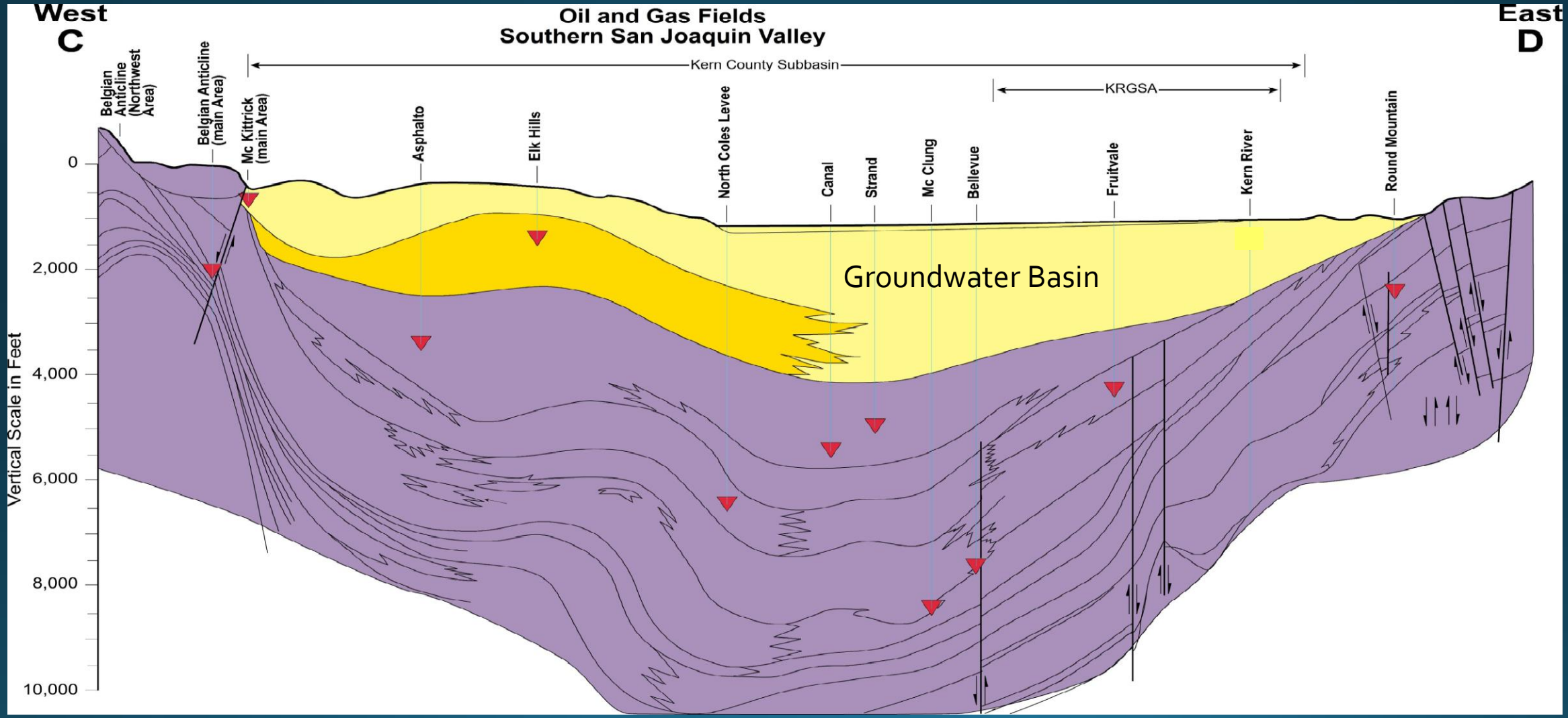
Regional Cross Section and Oil Fields



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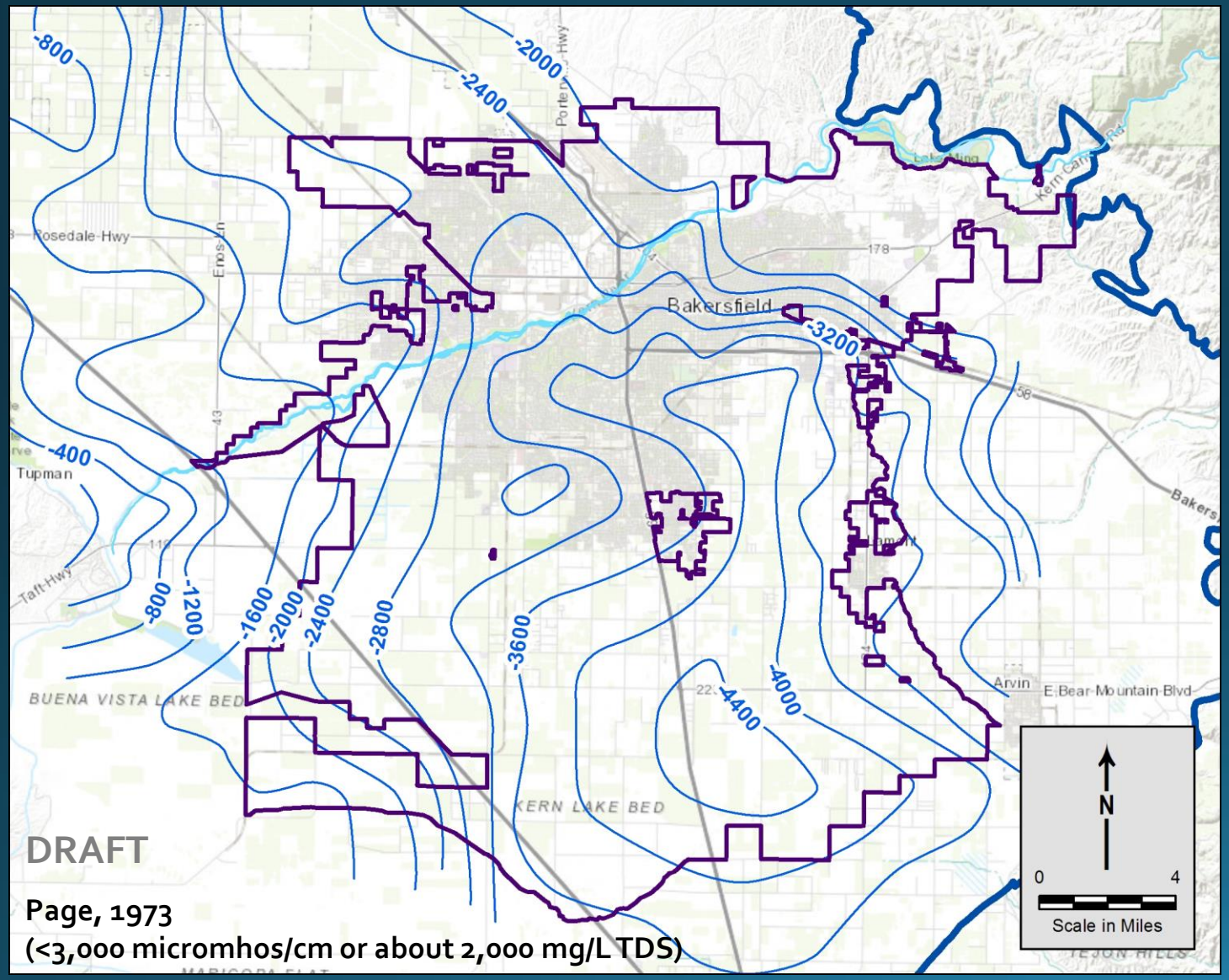
Basin Bottom – Base of Fresh Water



- USGS mapped the base of fresh water in 1973
- Provide depths to define the groundwater basin bottom
- Operationally, the basin is limited by elevated metals and other constituents at depth (almost all wells <1,100 feet deep)

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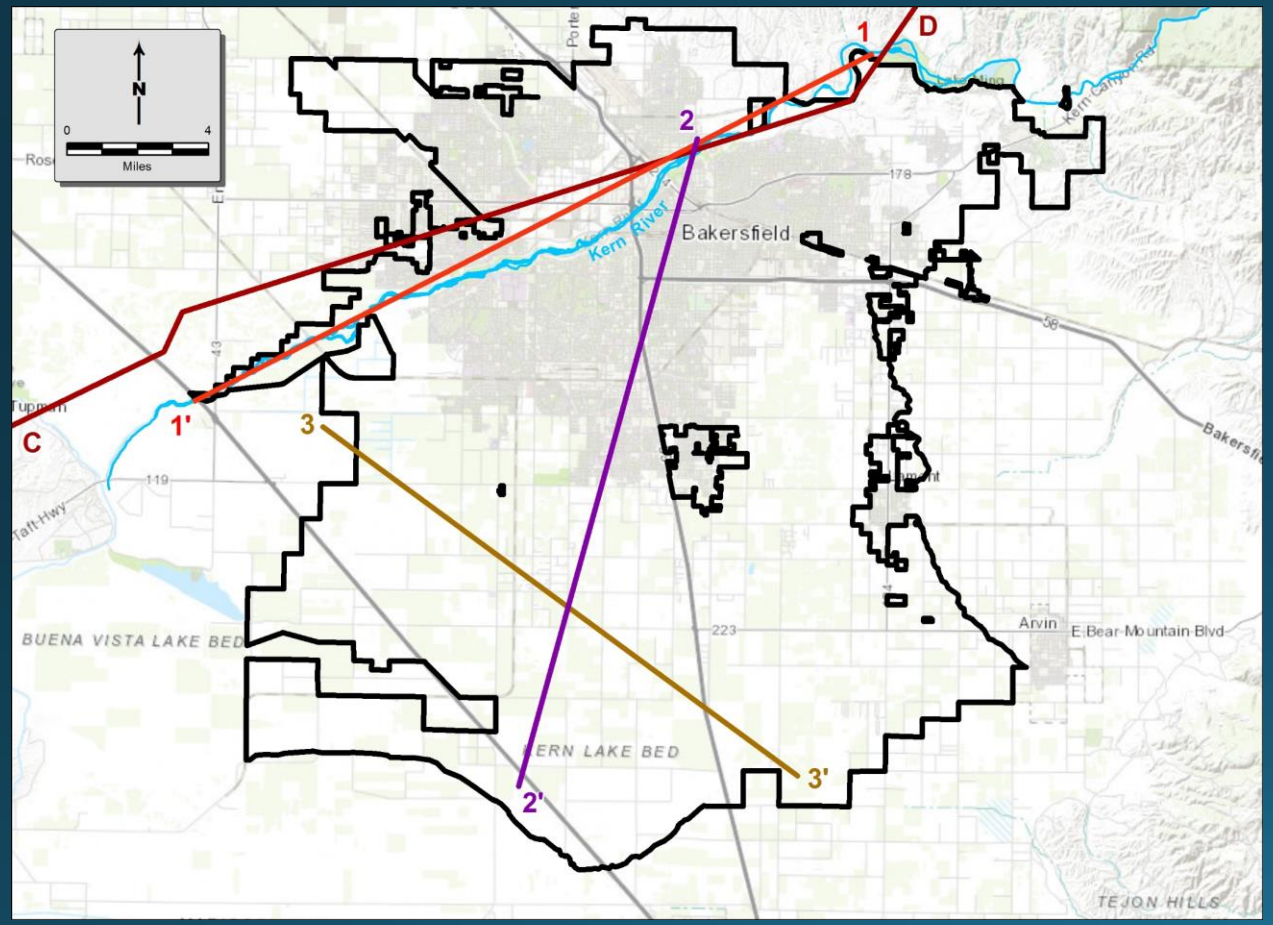
Cross Section Location Map



- Numerous working cross sections developed across KRGSA
- Illustrate principal aquifer and subsurface textures
- Developed using geophysical logs at large scale; reduced for convenience in report

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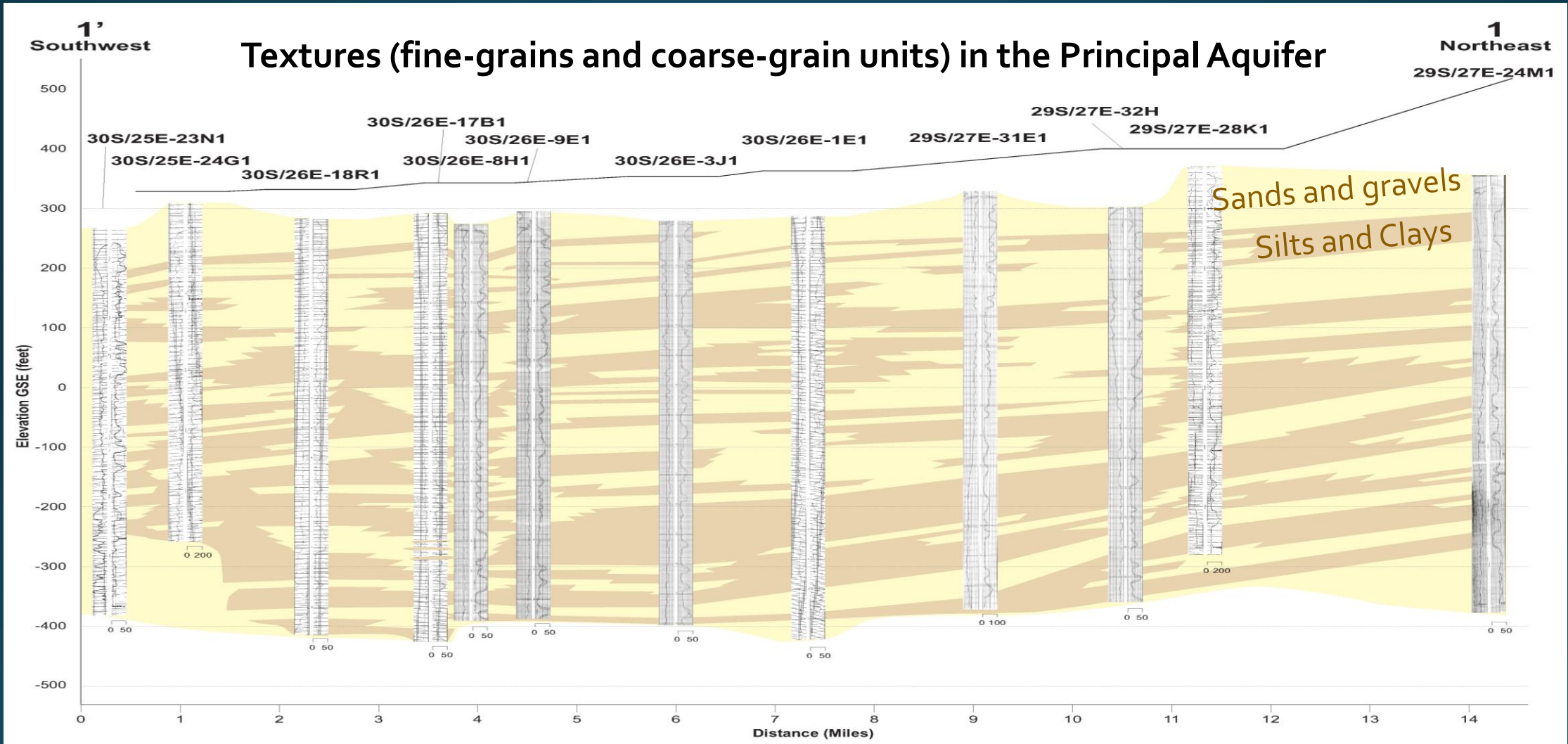
15-mile Cross Section along the Kern River



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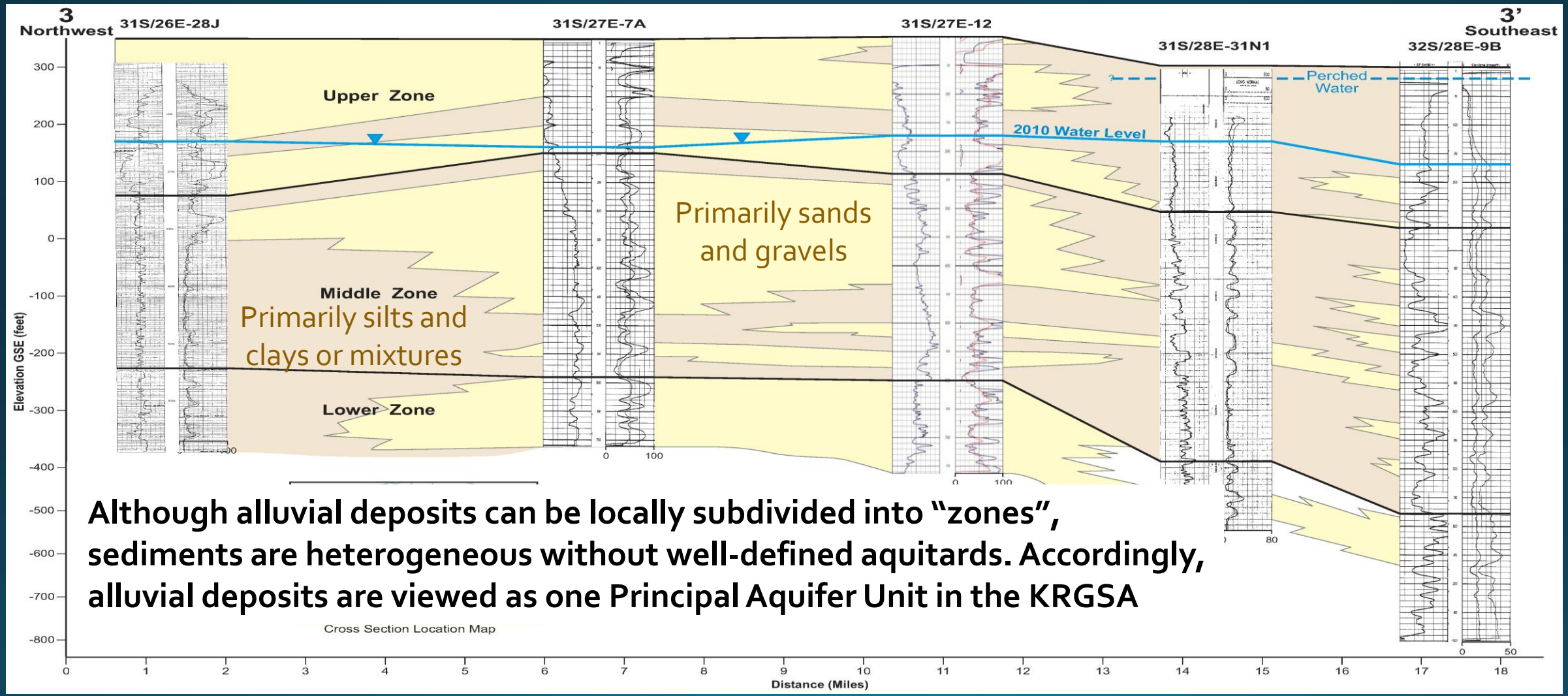
19-mile Cross Section in southern KRGSA



Although alluvial deposits can be locally subdivided into "zones", sediments are heterogeneous without well-defined aquitards. Accordingly, alluvial deposits are viewed as one Principal Aquifer Unit in the KRGSA

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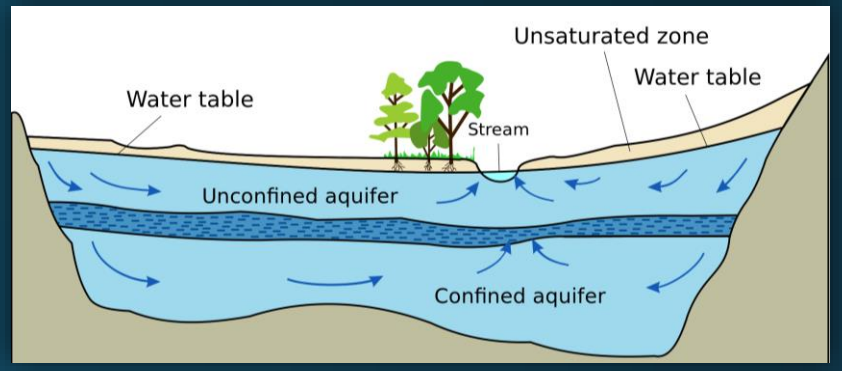
Groundwater Conditions Regulatory Requirements



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- Hydrographs (changes in groundwater levels over time)
- Groundwater Elevation Contour Maps
- Changes in groundwater in storage (between seasonal highs)
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- Groundwater Dependent Ecosystems

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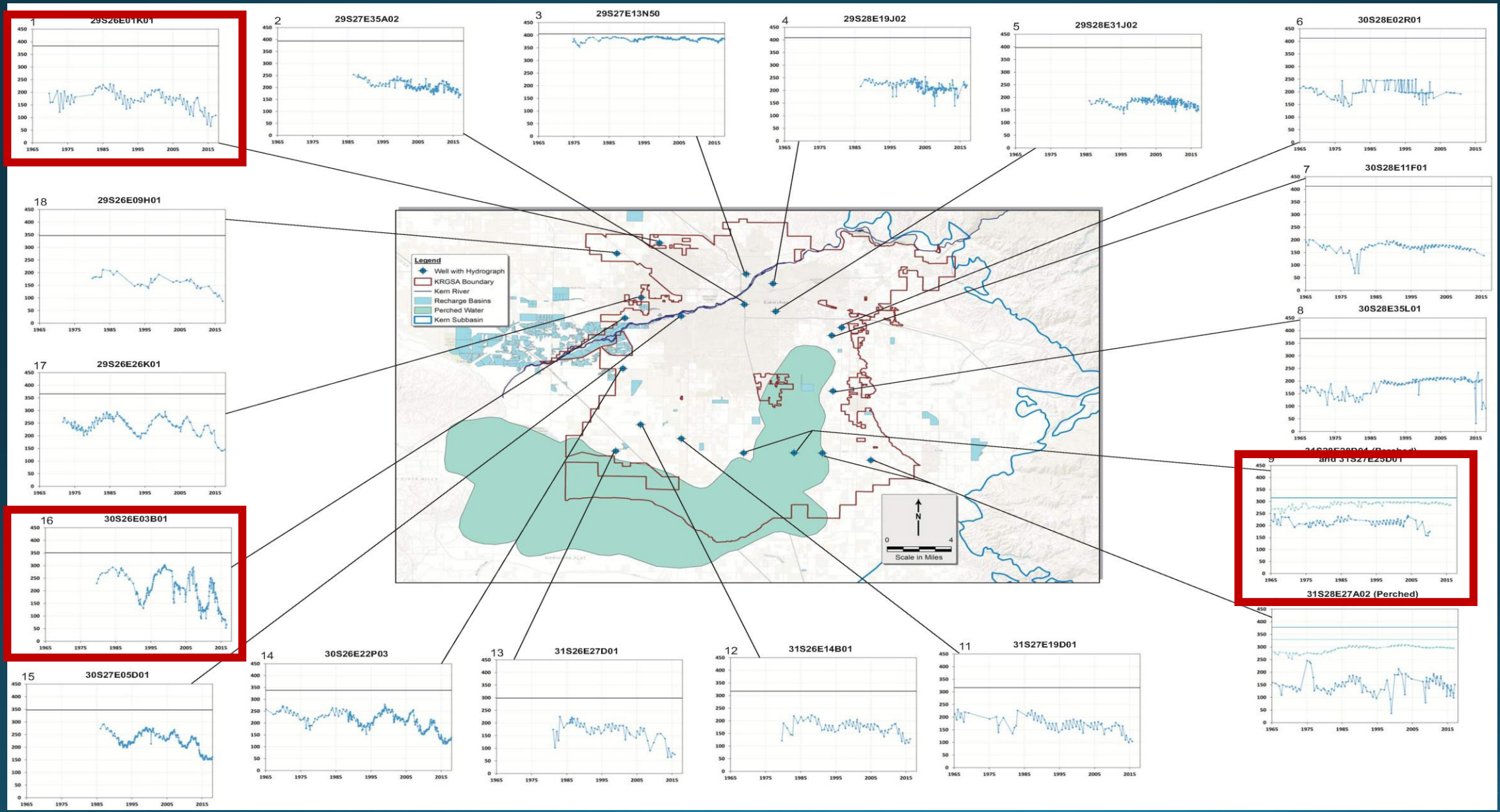
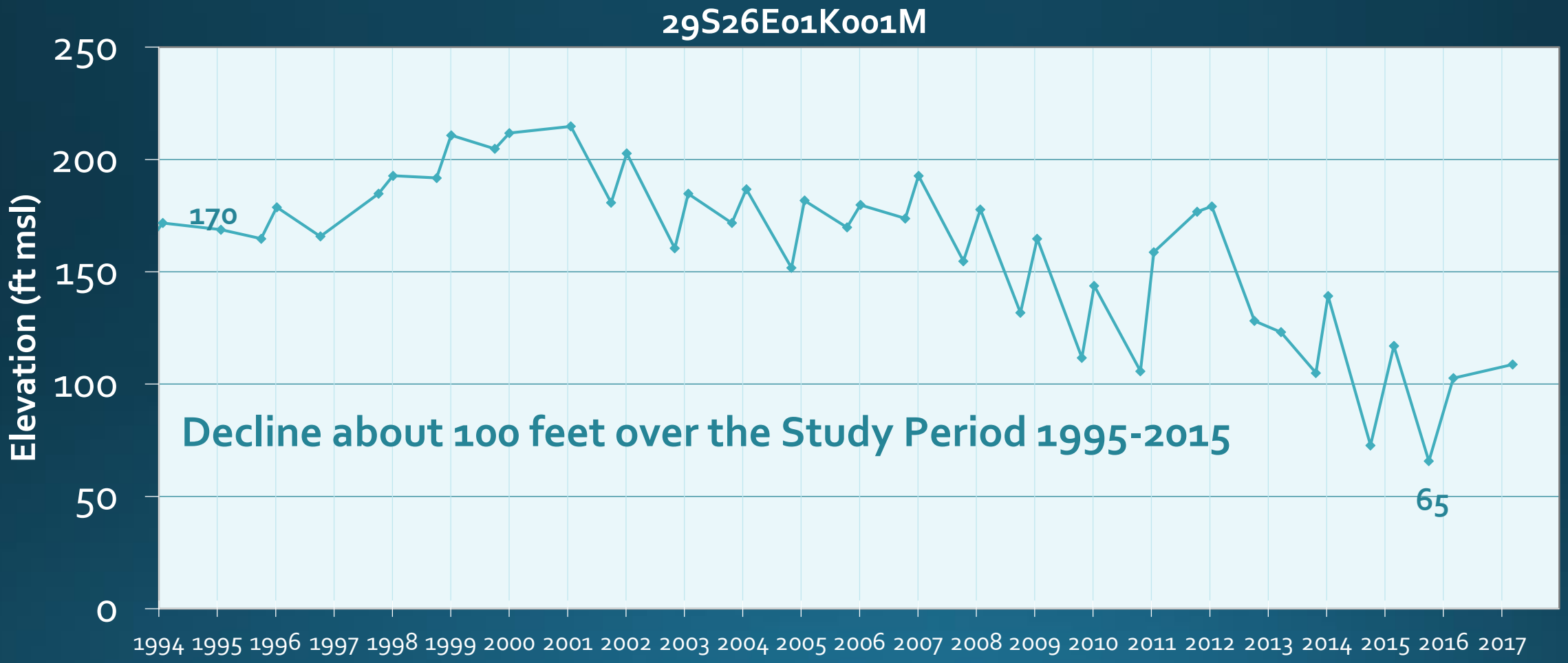
KRGSA Water Level Hydrographs 1965-2017



Northern Border KRGSA



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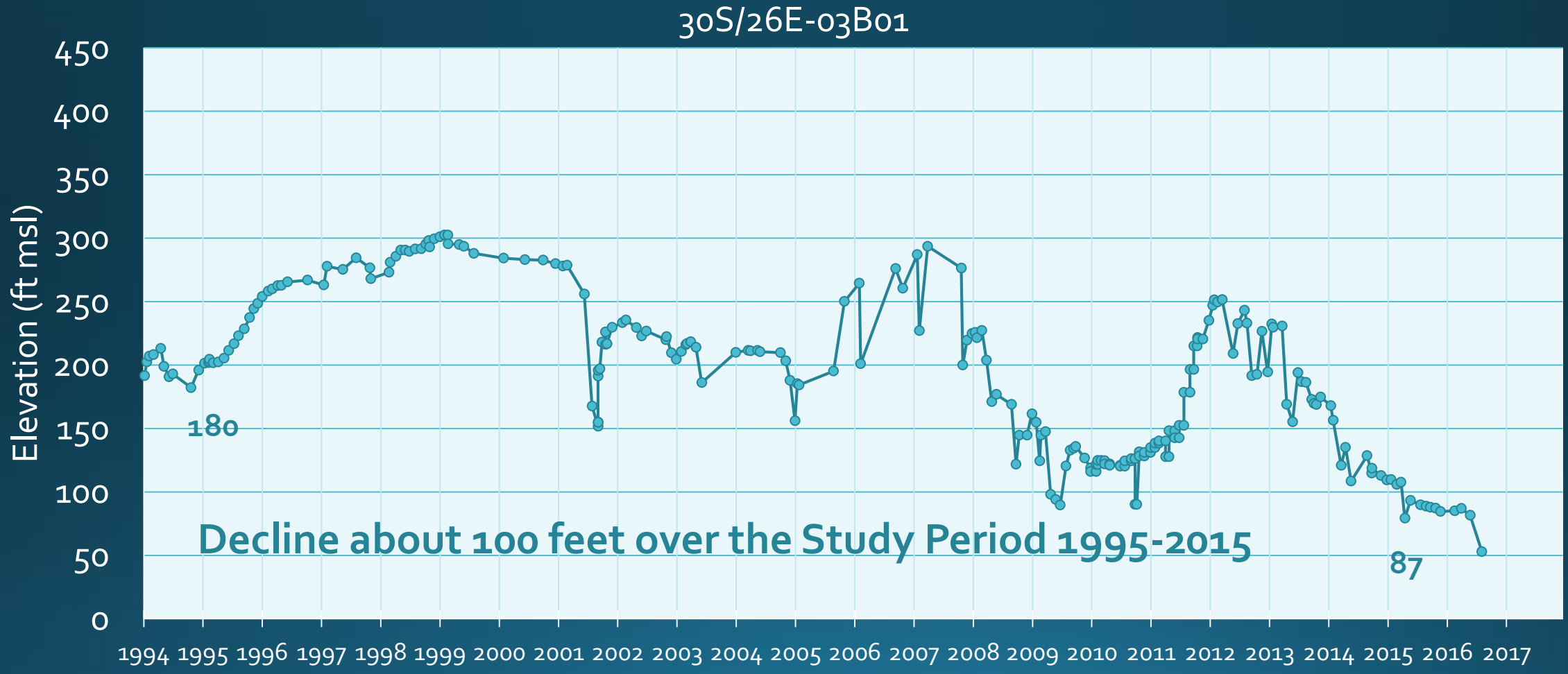
Western KRGSA (Banking Area)



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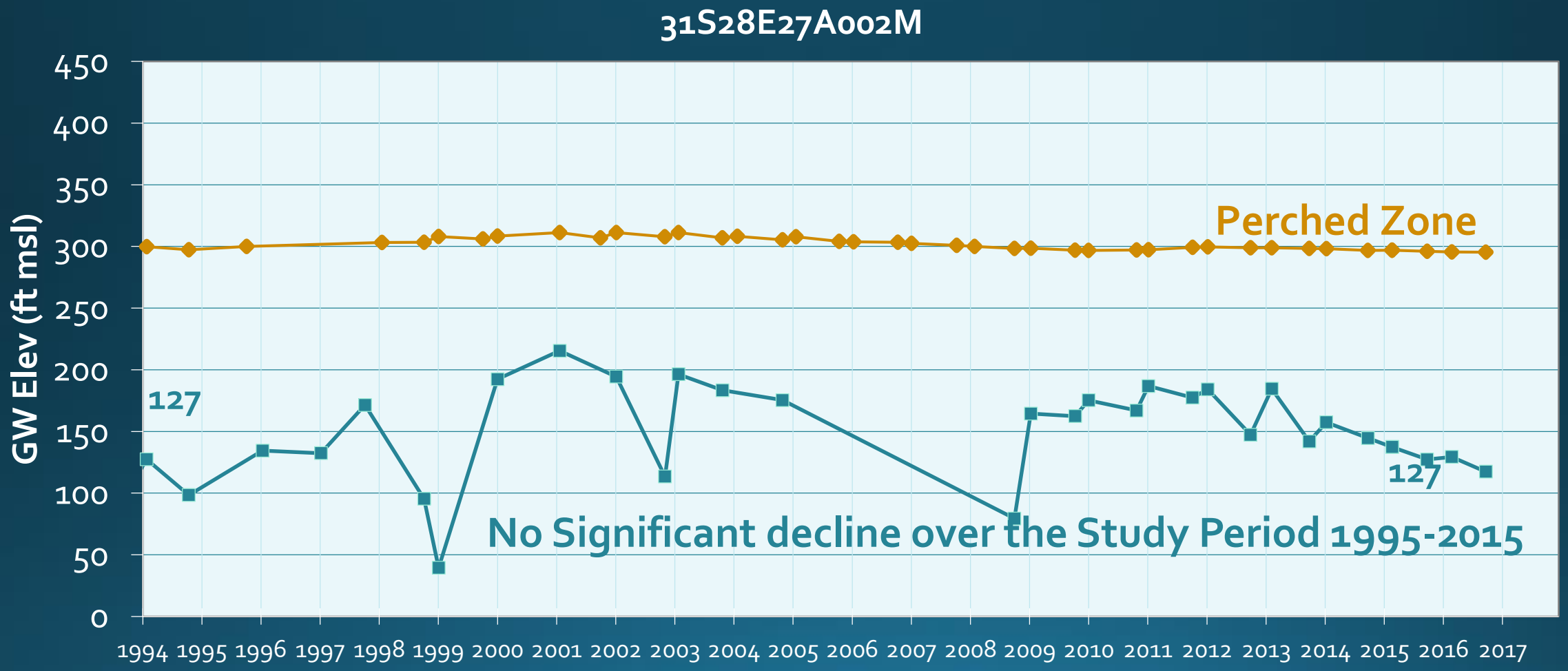
Southeastern KRGSA



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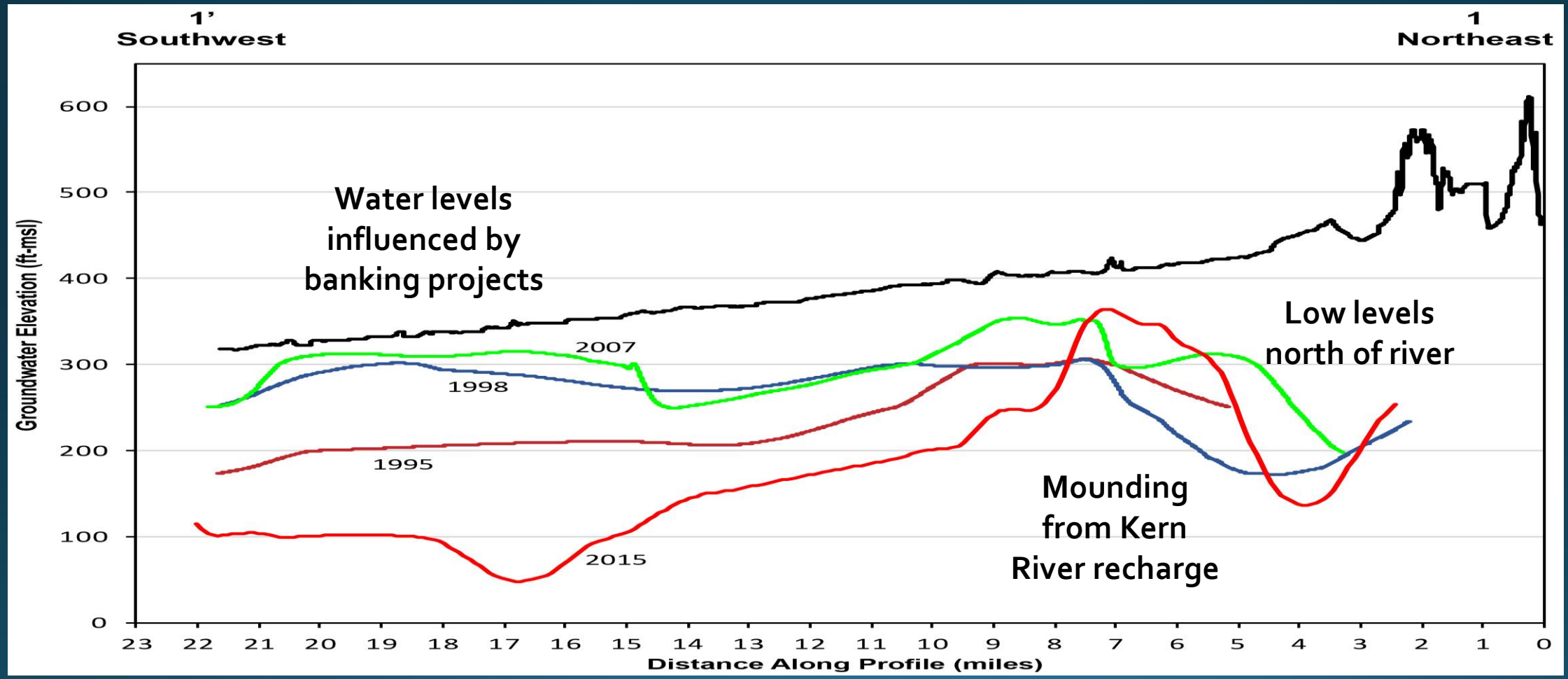
Hydrologic Profiles beneath the Kern River



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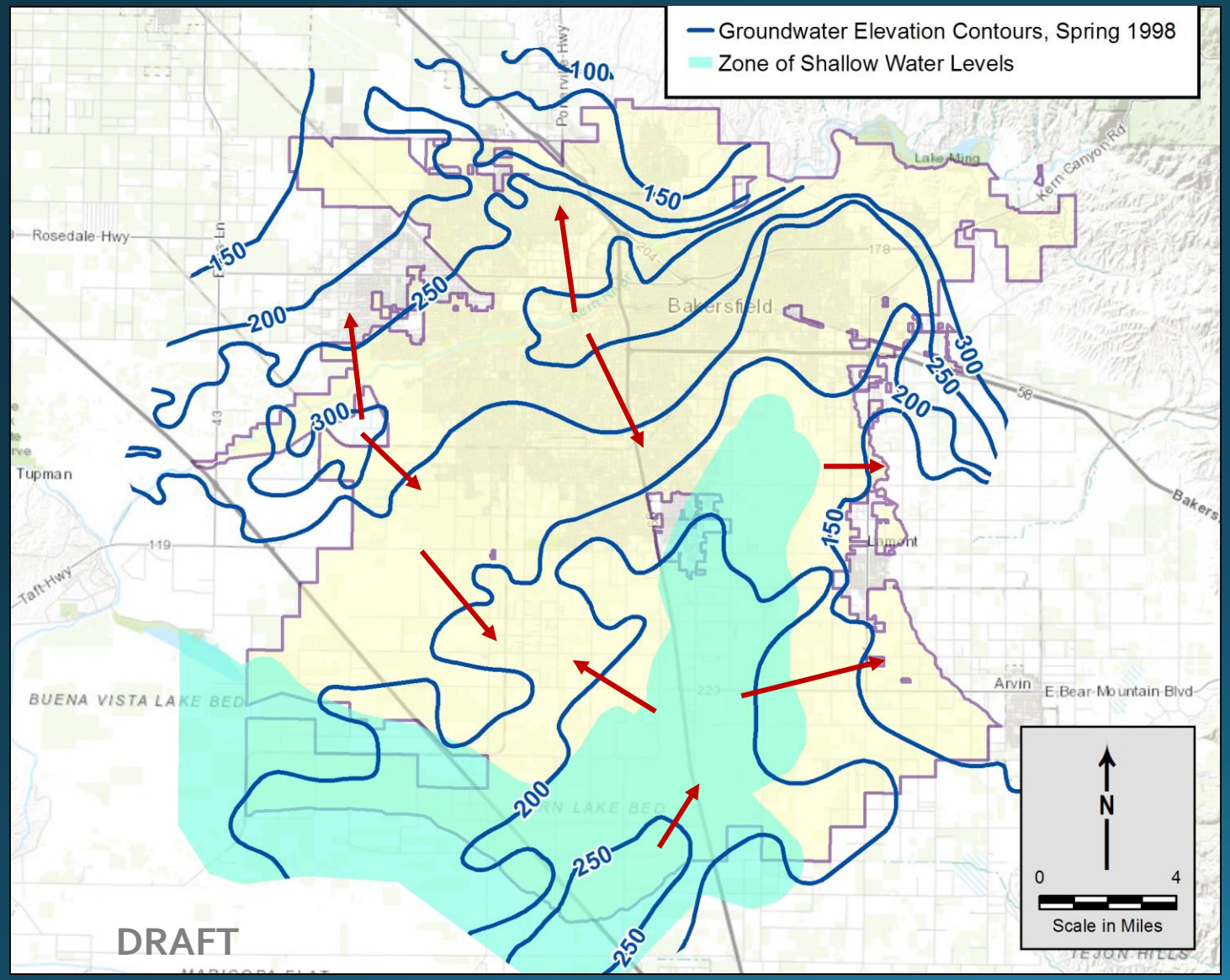
Groundwater Elevation Contours 1998



- 20 groundwater elevation contour maps (Spring data)
- Examined maps and data for perched layers (zone of shallow water levels)
- Example for wet year - Spring 1998

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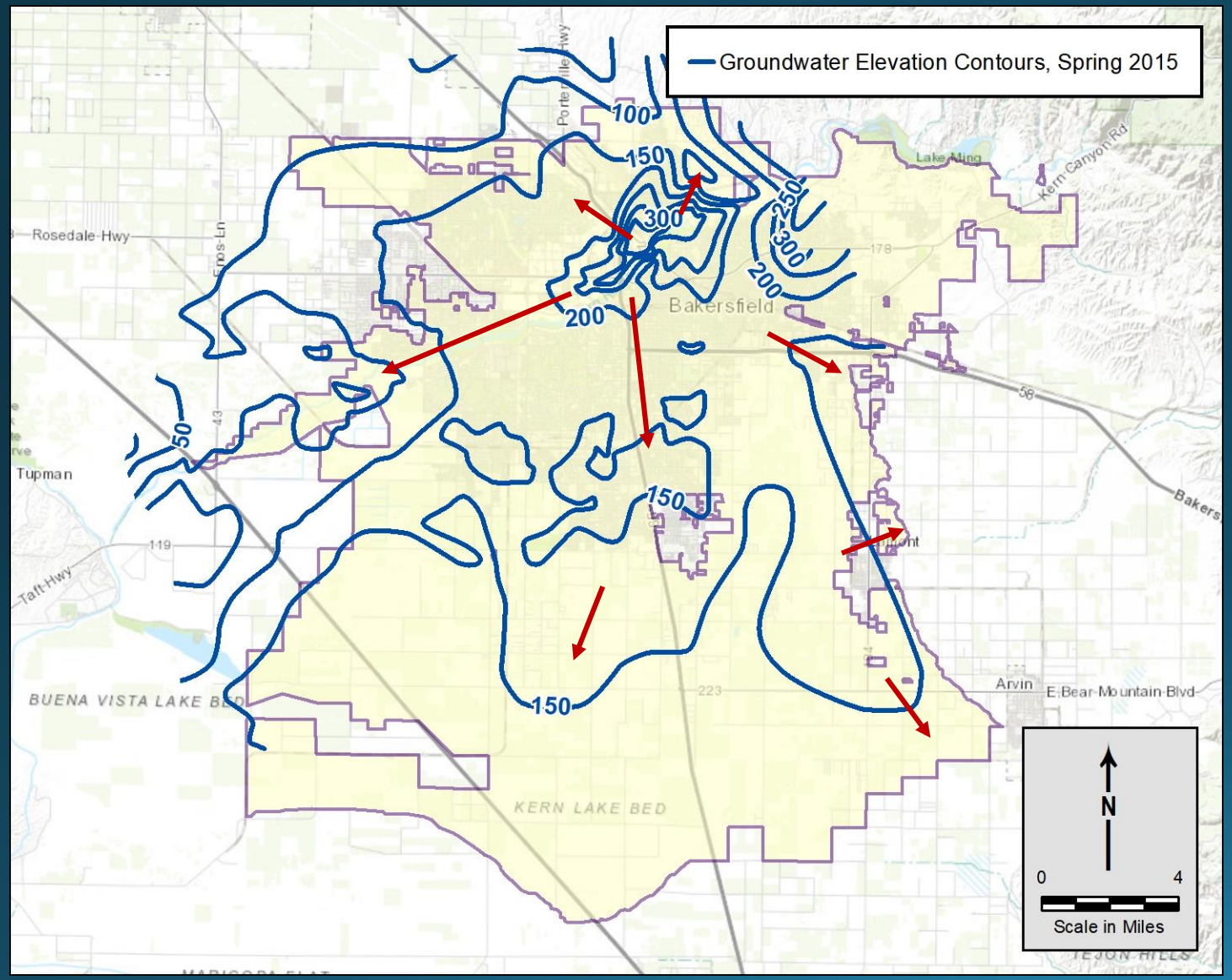
Groundwater Elevation Contours 2015



- Severe Drought year
- In general, higher water levels than surrounding areas
- Except for the river, groundwater is flowing out of the KRGSA

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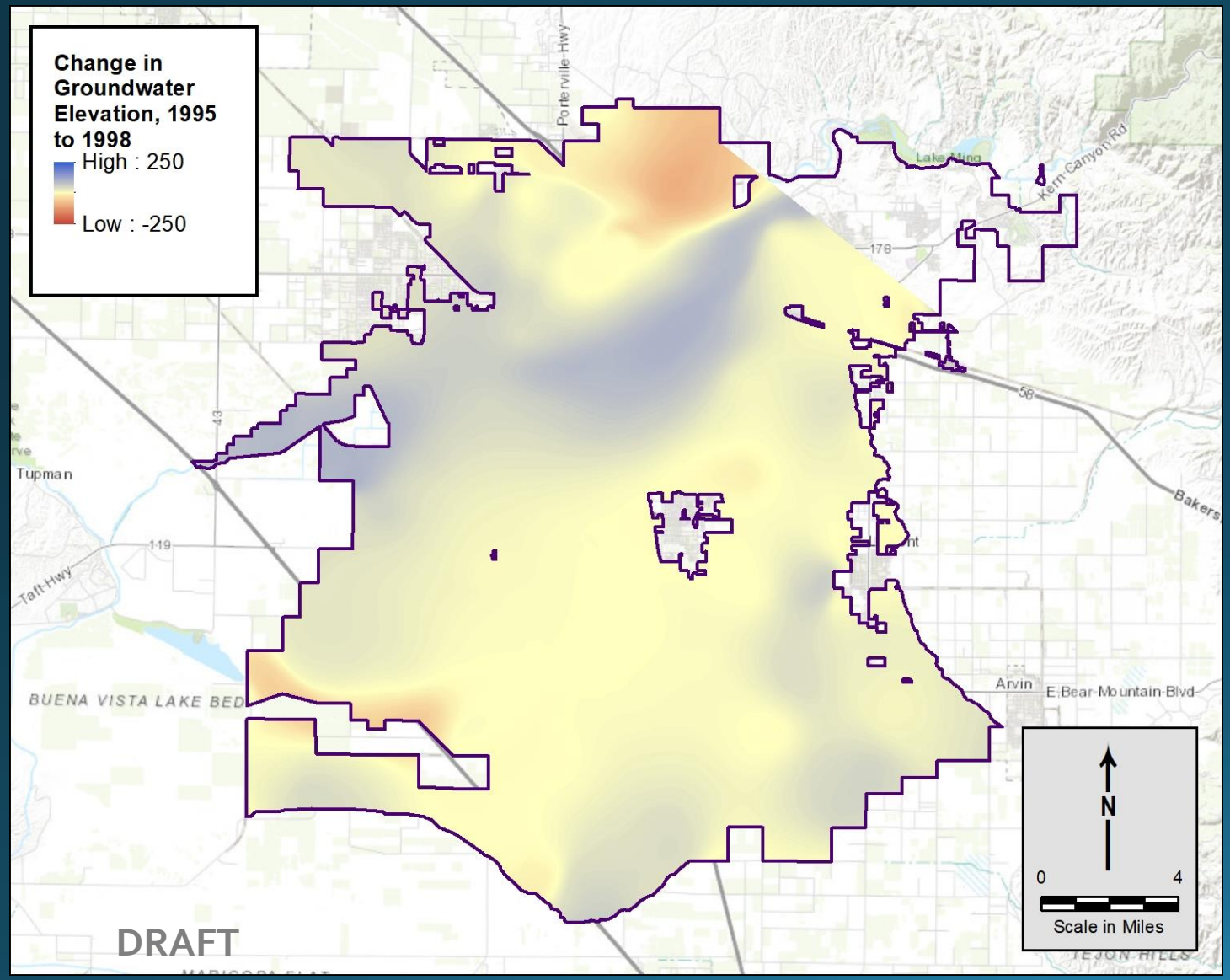
Change in Groundwater in Storage, 1995 to 1998



- Created 20 annual water levels change maps using KCWA Spring water level contour maps
- Blues areas indicate water level rise; red areas indicate water level declines
- Limited data create uncertainty for some areas and time periods

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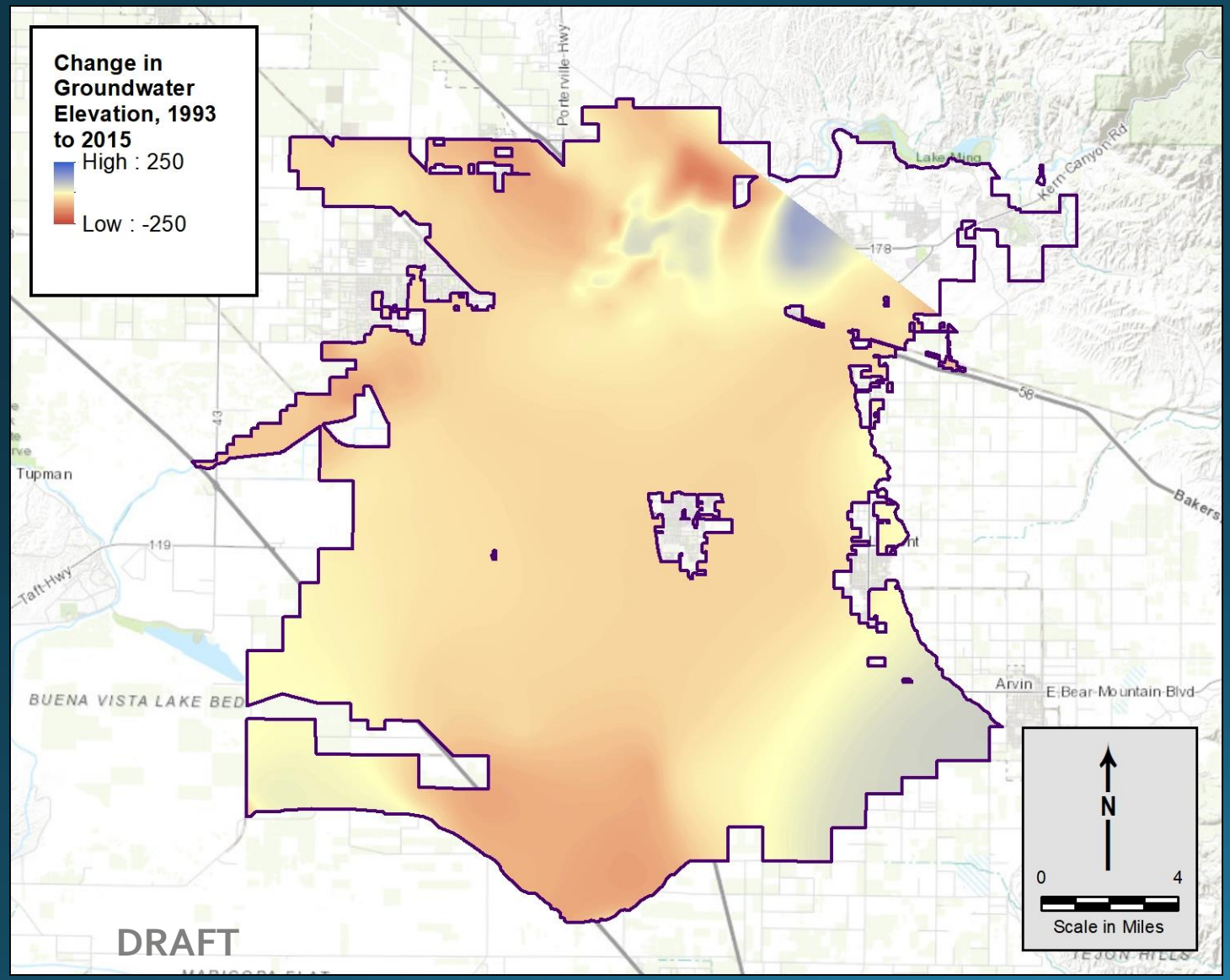
Change in Groundwater in Storage, 1993 to 2015



- Change in water levels over the entire study period
- Impacts of the recent drought result in water level declines over most of the KRGSA
- Some areas of uncertainty due to limited data

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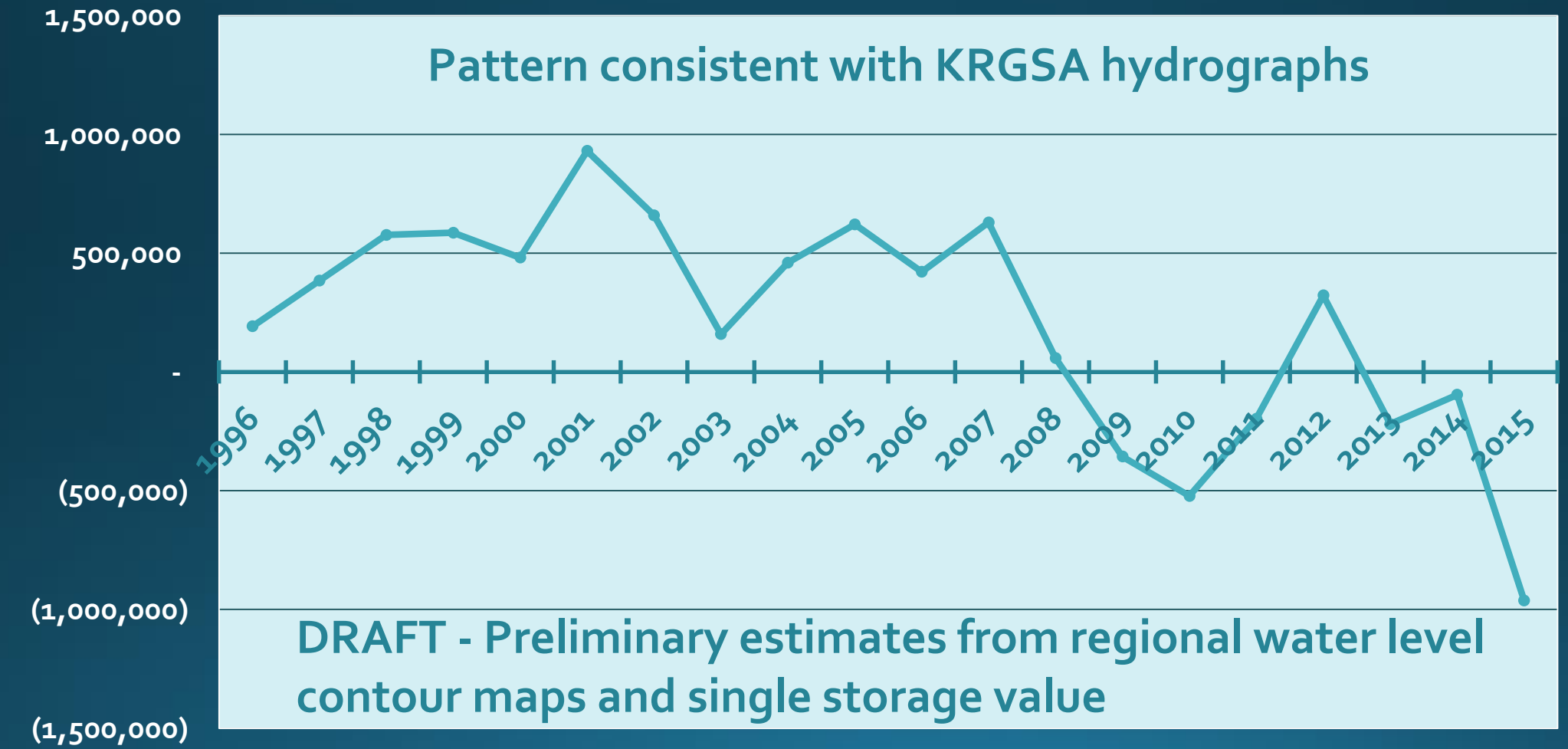
Cumulative Change in Storage from Annual Spring Water Level Contour Maps



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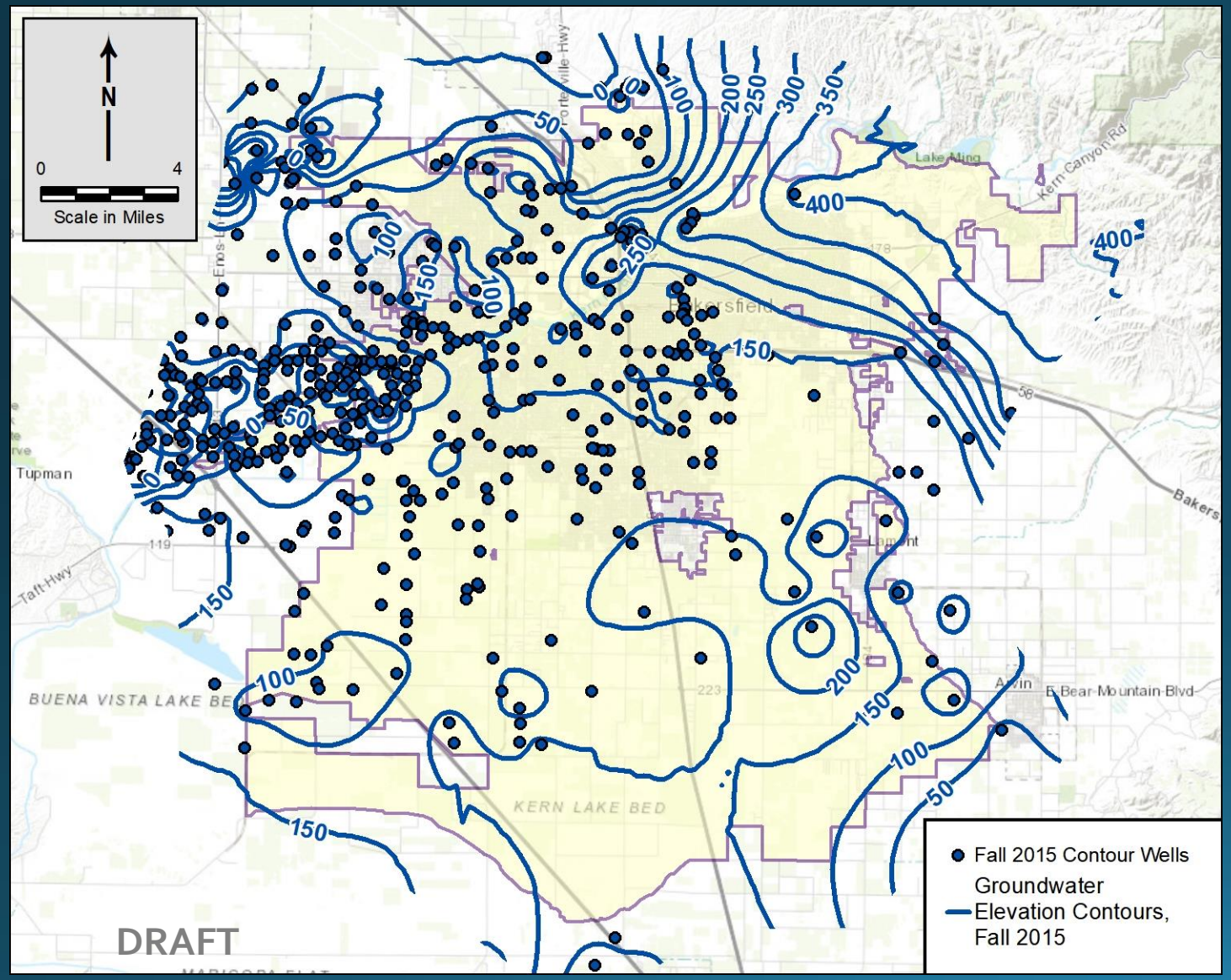
Minimum Groundwater Elevation Contours, Fall 2015



- Generated a groundwater elevation contour map for Fall 2015
- Represents minimum water levels in KRGSA
- Potential application to sustainability analysis and criteria
- Subsidence and other(?) undesirable results

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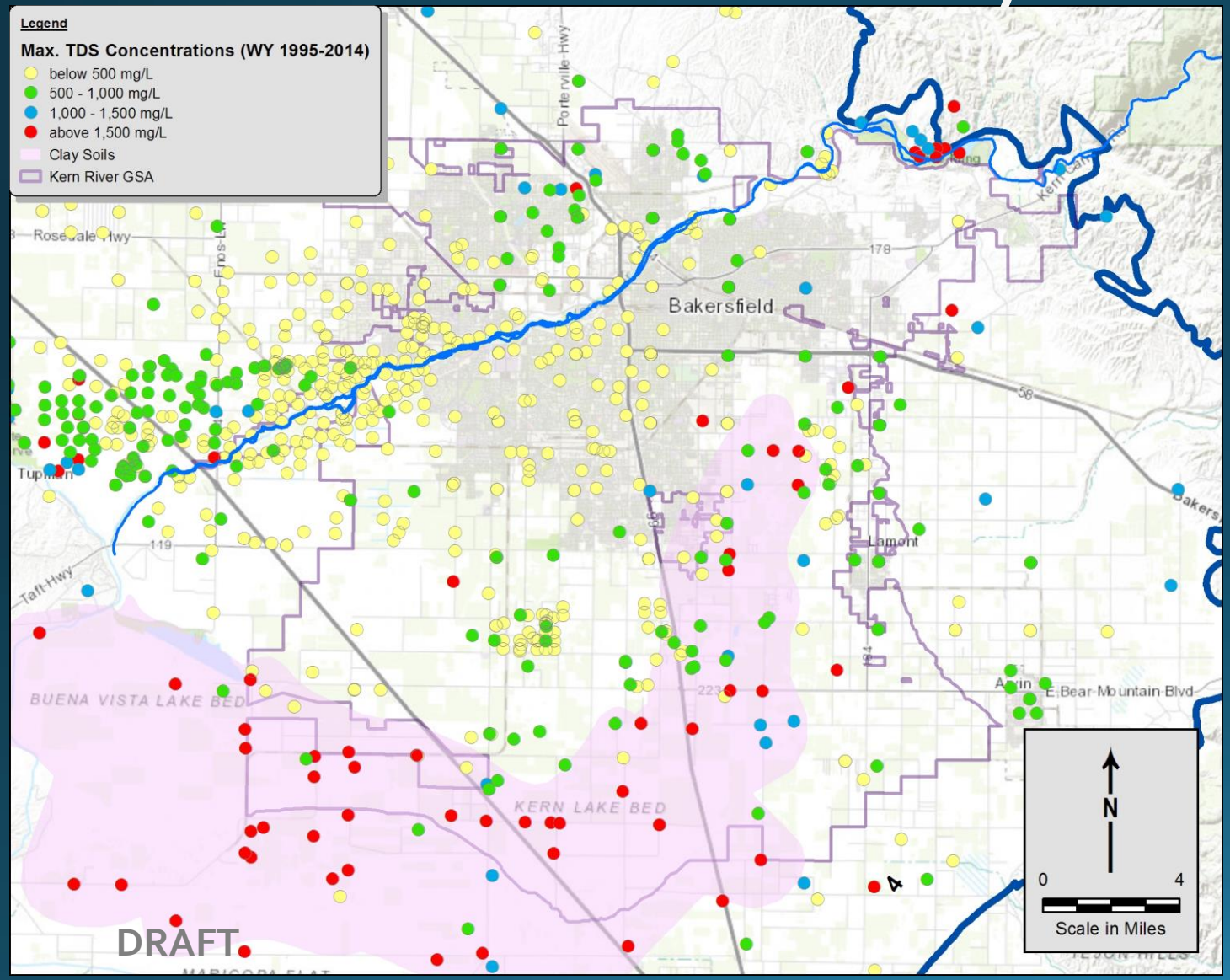
Groundwater Quality - Distribution of TDS



- Water quality database 1995 – 2014
- Total Dissolved Solids (TDS) below 1,000 mg/L over most of the KRGSA
- Elevated TDS values associated with clay-rich sediments and areas of perched groundwater

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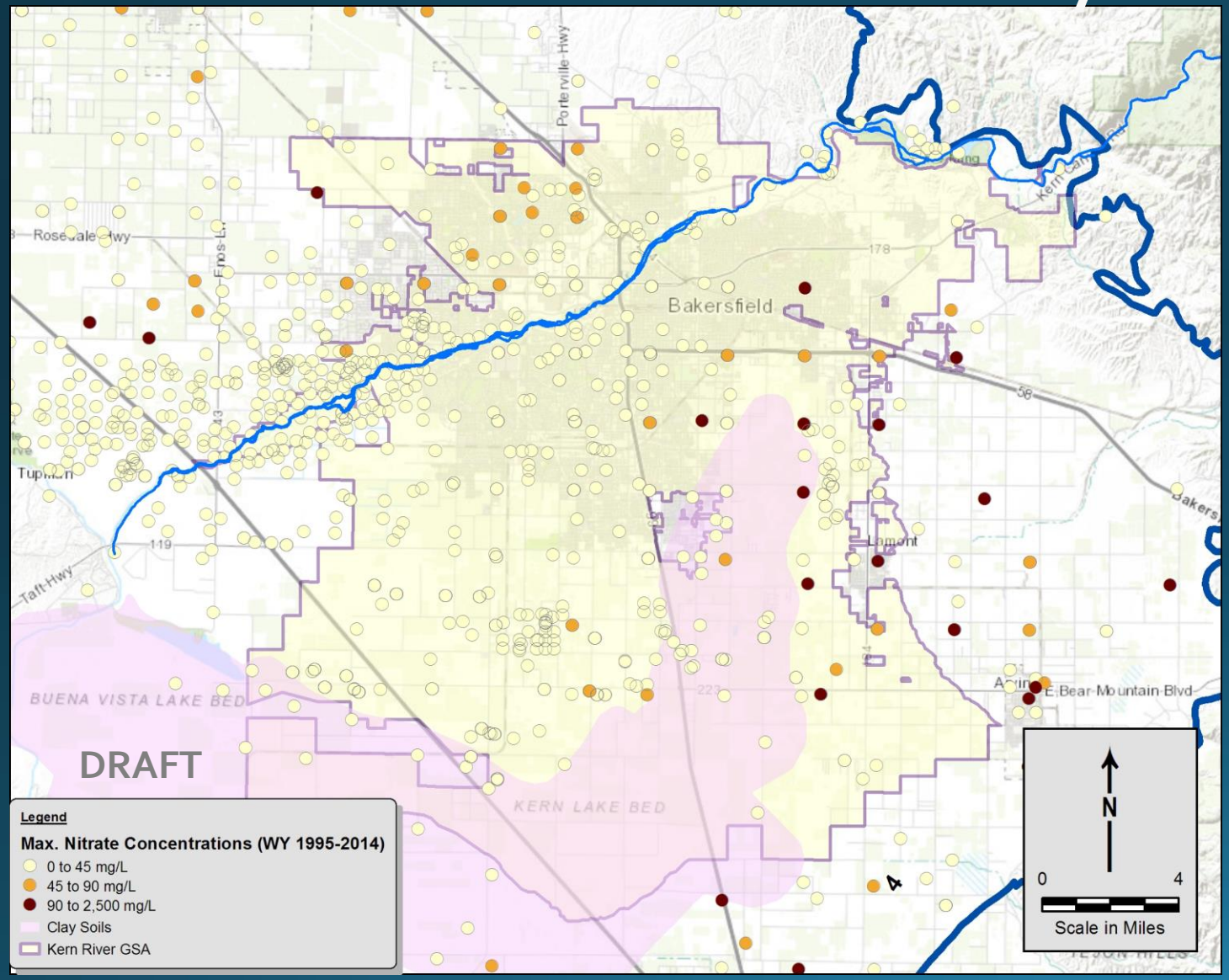
Groundwater Quality – Nitrate (NO_3)



- Most of the area has concentrations below MCL
- Localized areas of elevated nitrate exceeding the MCL
- Areas of limited data
- Additional water quality data from Cal Water

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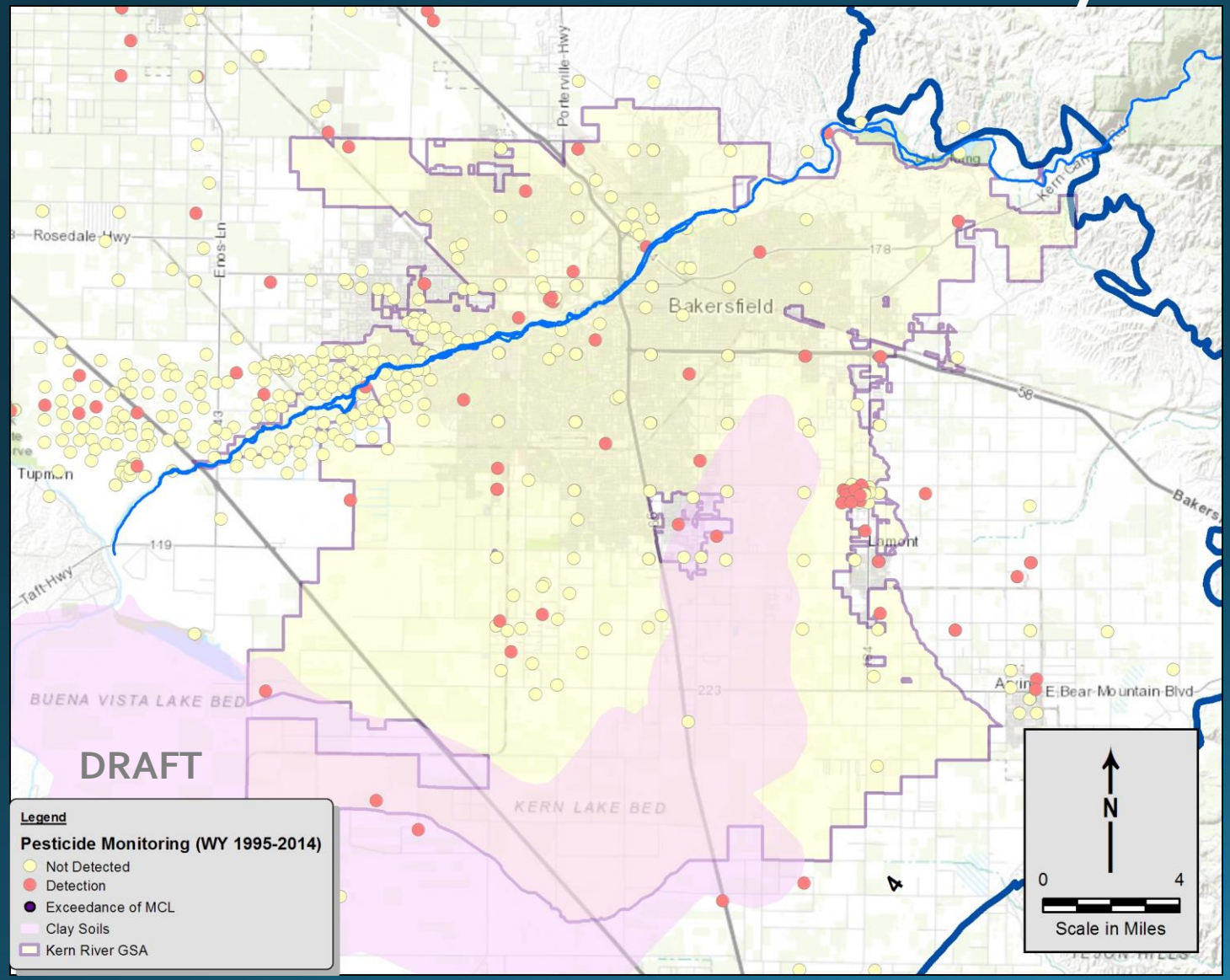
Groundwater Quality - Pesticides



- Localized areas of pesticides detected in groundwater
- No concentrations exceeding MCLs
- Additional water quality data available from Cal Water

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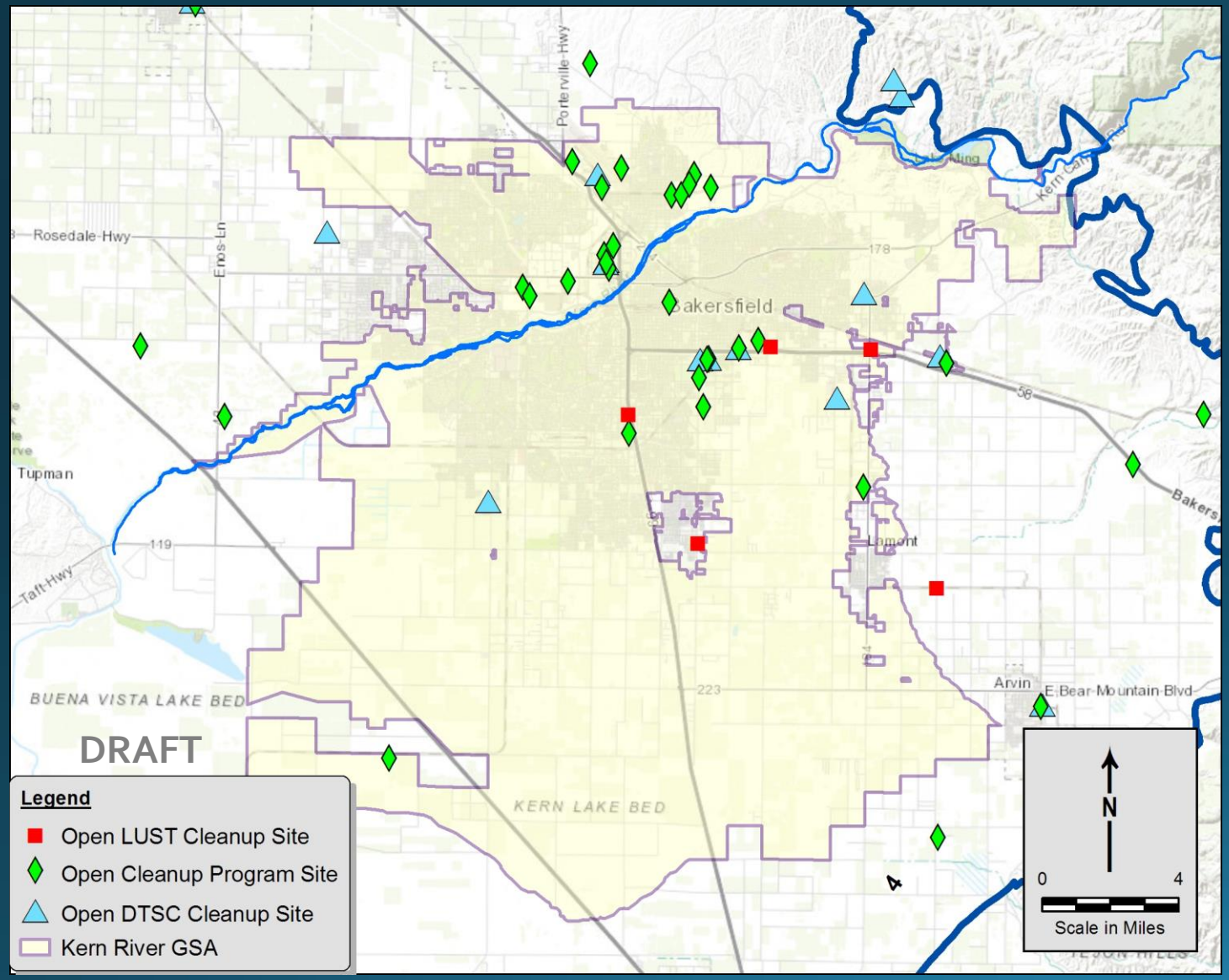
Groundwater Quality – Environmental Cleanup Sites



- Environmental Cleanup sites under the regulation of the Central Valley Water Board
- Data available from GeoTracker (state website)
- Only active (open) sites are included

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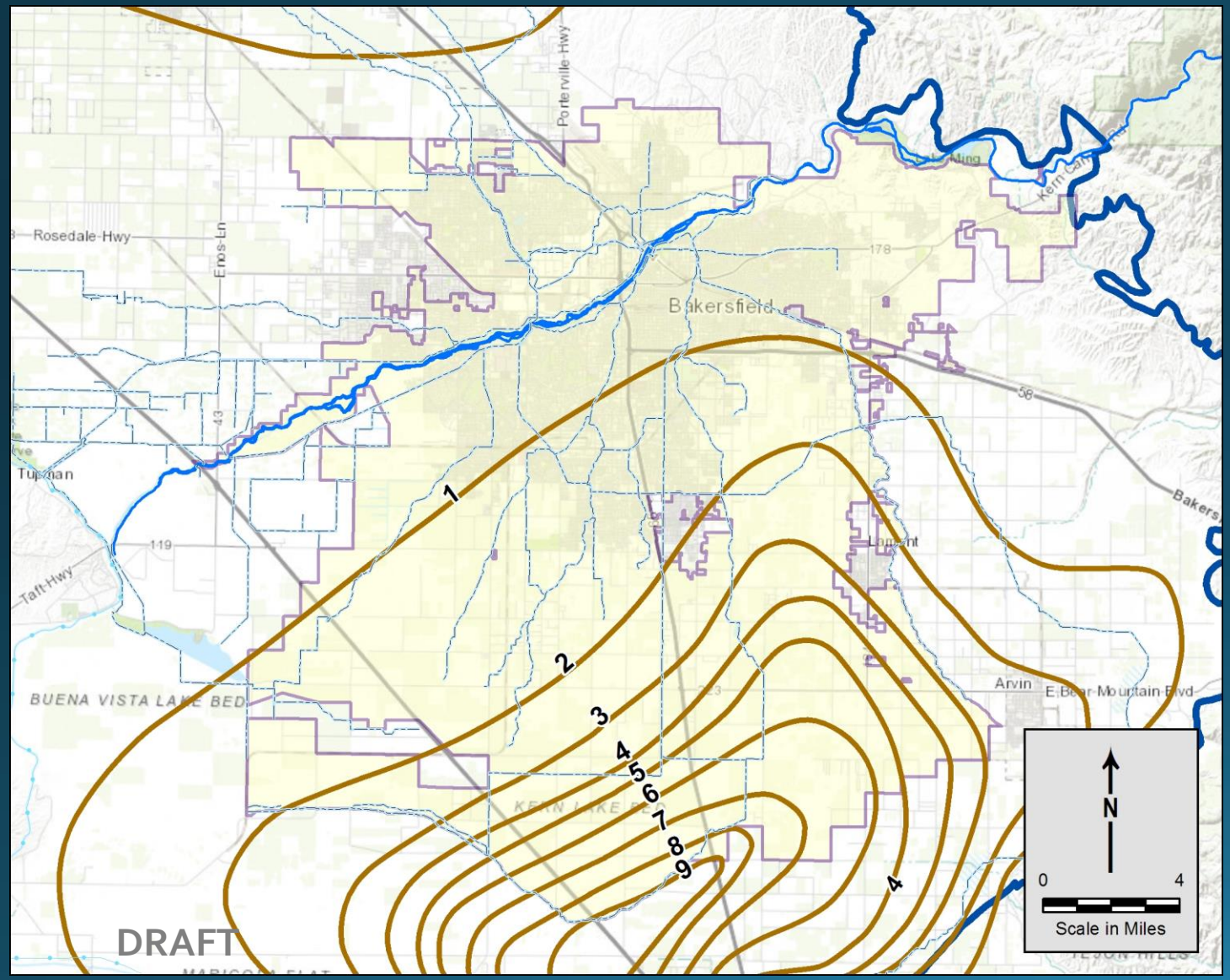
KRGSA Historical Subsidence 1926-1970



- Historical subsidence mapped by USGS (in feet)
- Associated with clay sediments in the southern portion of the KRGSA

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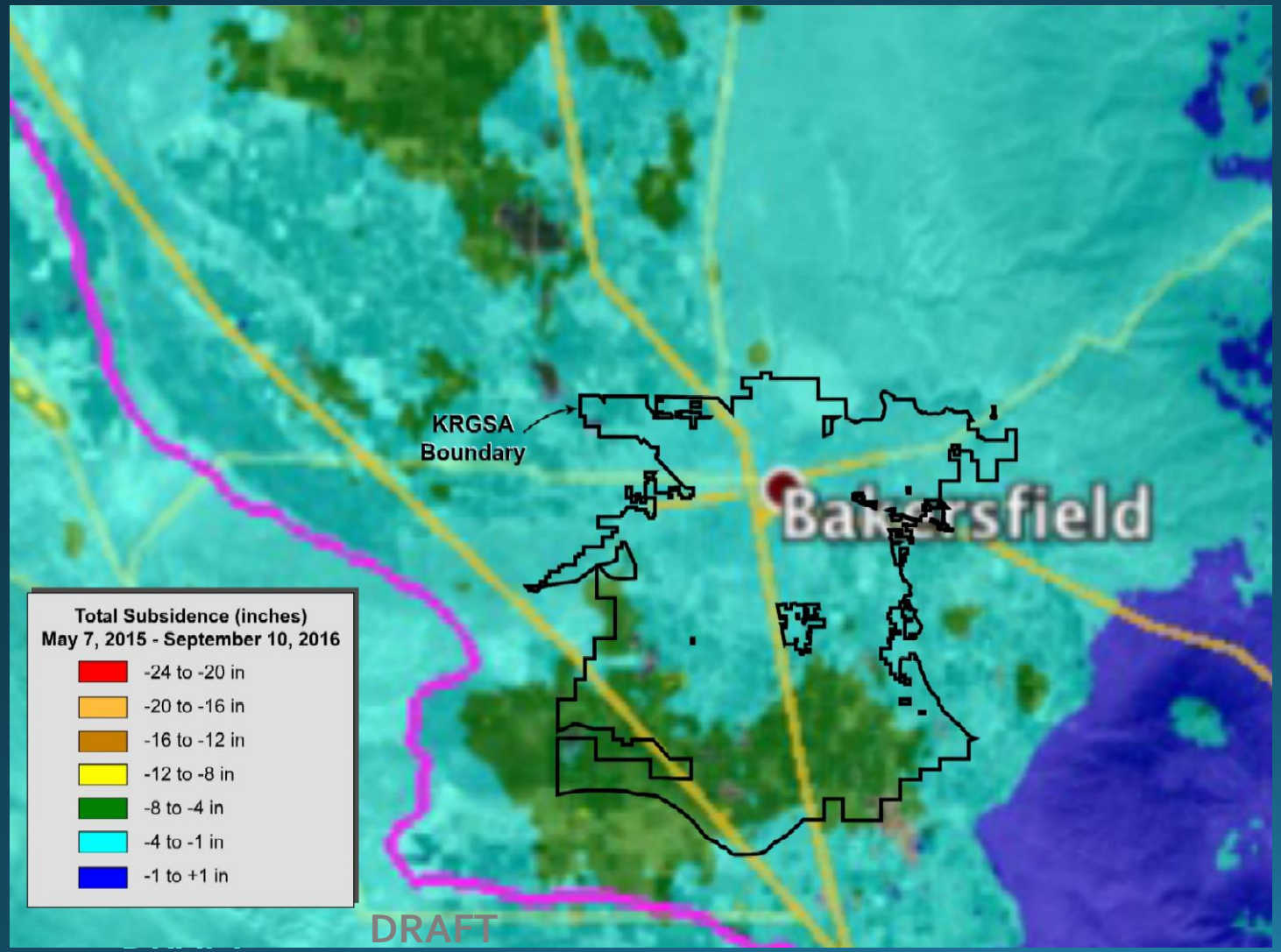
Recent Subsidence 2015 - 2016



- Analyzed by Jet Propulsion Laboratory
- 4 to 8 inches of recent subsidence indicated in the southern KRGSA.

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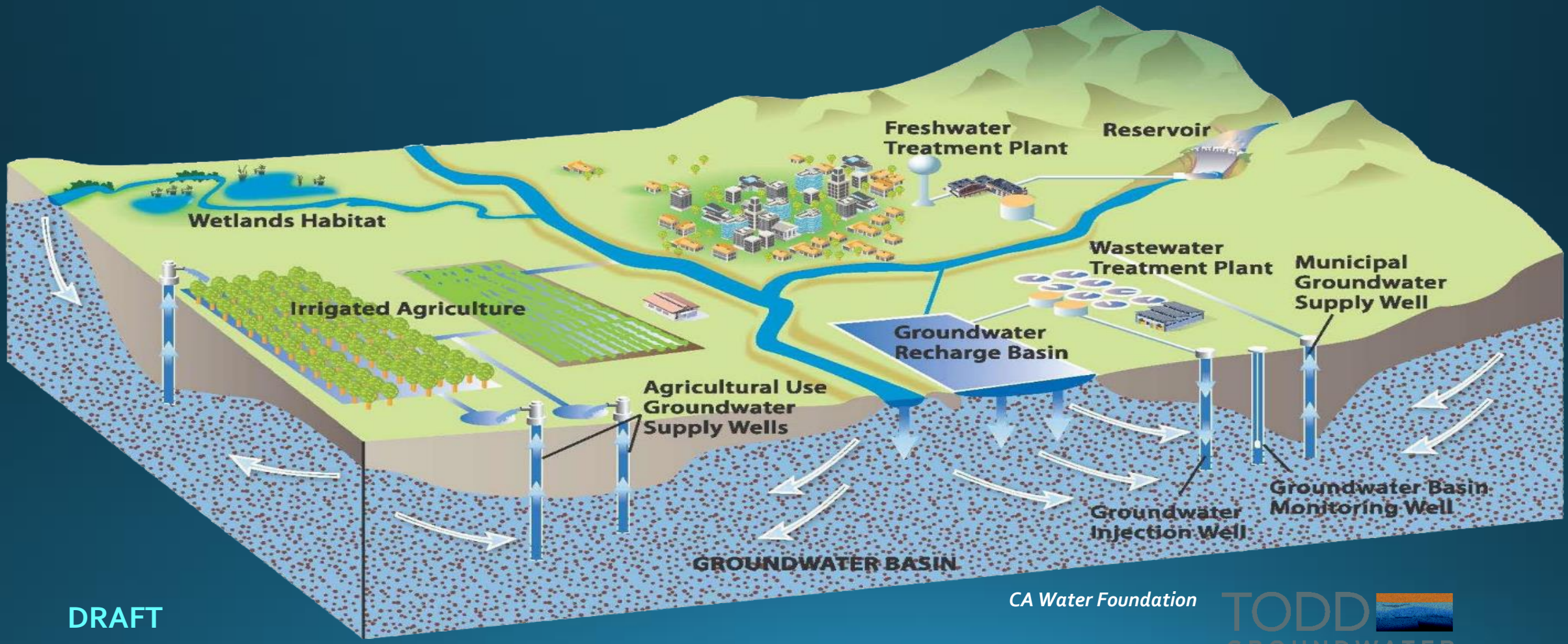
Next Step – Finalize KRGSA Water Budget



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CA Water Foundation

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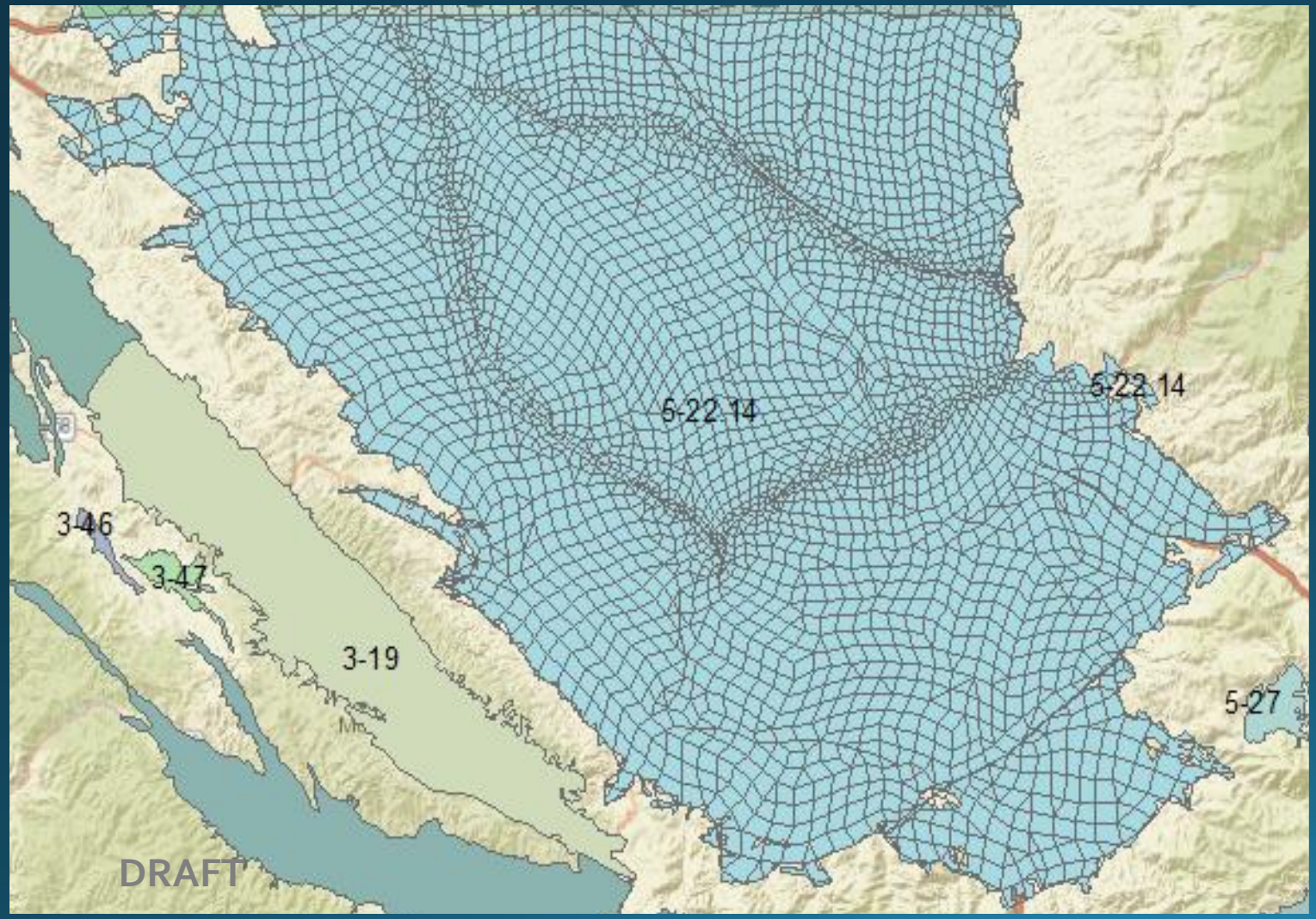
Incorporate KRGSA data into the Basin-wide Groundwater Model



- Received early release of C2VSim model
- Model runs successfully; working on pre-processing
- Involving former DWR modeler who built the current version as a subconsultant
- On-call advisor to expedite schedule

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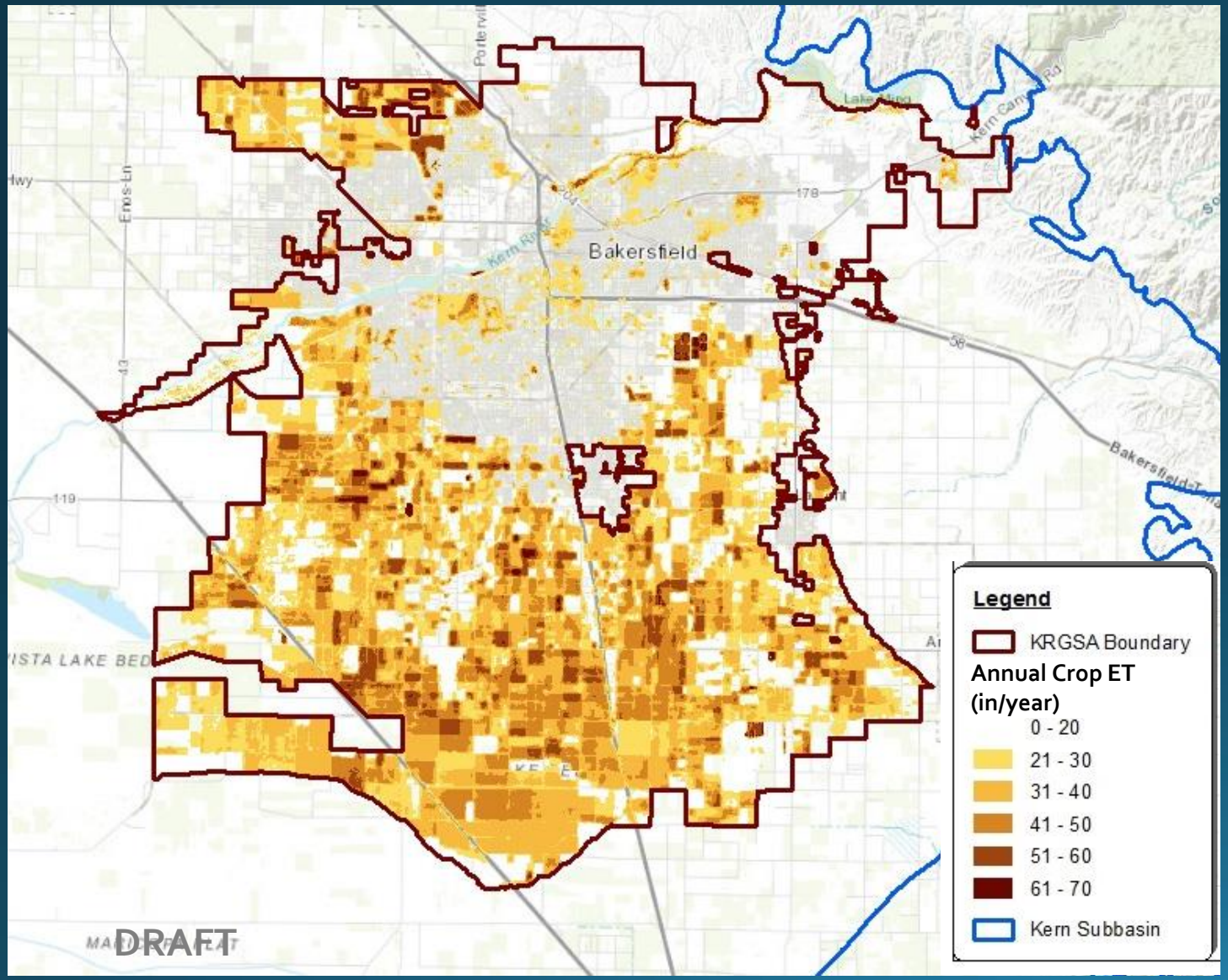
METRIC Data Processing



- 240 METRIC maps covering the entire Kern Subbasin
- ET data for each 30m x 30m pixel (1/4 acre)
- More than 800,000 pixels in KRGSA
- Processing to limit data to agricultural areas
- Reconcile with water budgets

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Discussion and Questions

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